

---

## E. Structure Elevation

This section supplements the information provided in Parts I through VIII. For Structure Elevation resources, see Part X C.12.

### ***E.1 Overview***

Structure elevation activities generally involve physically raising an existing structure to an elevation at or above the BFE, or higher if required by FEMA or local ordinance. Structure elevation may be achieved through a variety of methods, including elevating on continuous foundation walls; elevating on open foundations, such as piles, piers, posts, or columns; and elevating on fill. Foundations must be designed to properly address all loads and be appropriately connected to the floor structure above, and utilities must be properly elevated as well. Buildings proposed for elevation must be structurally sound and capable of being elevated safely.

#### **E.1.1 Eligible Design Standards**

At a minimum, FEMA requires Applicants and subapplicants to design all structure elevation projects in accordance with the NFIP standards outlined in 44 CFR Part 60. For additional information about the NFIP and structure elevation projects, see Part X C.1.

FEMA encourages Applicants and subapplicants to design all structure elevation projects in accordance with ASCE/SEI 24-05.

Buildings proposed for structure elevation must be structurally sound and capable of being elevated safely. In addition, important design considerations for structure elevations consistent with 44 CFR Part 60 are as follows:

- ◆ The lowest floor of structures must be elevated to the BFE or to the elevation specified in the local ordinance, if higher. Upon completion of the elevation work, an Elevation Certificate (FEMA Form 81-31) verifying “as built” elevations will be completed to ensure that the structure complies with the local floodplain ordinance, and NFIP floodplain management and HMA grant requirements.
- ◆ Elevation projects must be designed and adequately anchored to prevent flotation, collapse, or lateral movement of the structure due to hydrodynamic and hydrostatic loads, including the effects of buoyancy. It is recommended that an engineer certify that the design elevation will withstand the depth and velocity of 100-year flood events (hydrostatic and hydrodynamic loads), any potential increase in wind load, or any other relevant load factors.
- ◆ For elevation projects in Zone V with open foundations (piles, piers, posts, or columns), the space below the lowest floor must be free of obstructions or constructed with non-supporting breakaway walls, open wood lattice-work, or screening intended to collapse under wind and water loads without causing collapse, displacement, or other structural damage to the elevated portion of the building or supporting foundation system. Guidance on free-of-obstruction and breakaway wall requirements is available in FEMA TB-5, *Free-of-Obstruction Requirements*, 2008, and FEMA TB-9, *Design and Construction Guidance for Breakaway Walls Below Elevated Coastal Buildings*, 2008.

- 
- ◆ For elevation projects on continuous foundation walls with fully enclosed areas below the lowest floor, the area must be used solely for parking of vehicles, building access, or storage as identified in 44 CFR Section 60.3(c)(5).
  - ◆ Elevation projects on continuous foundation walls must be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs to meet these criteria must be certified by a registered Professional Engineer or meet or exceed criteria found in 44 CFR Section 60.3(c)(5). Guidance on meeting this requirement can be found in FEMA TB-1, *Openings in Foundation Walls and Walls of Enclosures*, 2008.

## ***E.2 Elevation Methods***

Standard structure elevation methods are identified in FEMA Publication P-312 Homeowner's Guide to Retrofitting – Second Edition, December 2009, and in FEMA 347, *Above the Flood: Elevating Your Flood Prone House*, May 2000. In addition, FEMA has developed guidance for the design of appropriate foundations based on the requirements of the International Codes and other applicable standards. This guidance is provided in FEMA 550 and is available for use with HMA structure elevation projects. In addition, FEMA encourages Applicants and subapplicants to design all structure elevation projects in accordance with ASCE/SEI 24-05.

Available elevation methods, which are thoroughly described in both FEMA Publication P-312 (Chapter 5) and FEMA 347 include:

- ◆ Elevating the existing structure onto piles, posts, or piers;
- ◆ Filling in the basement and replacing it with an elevated floor; and
- ◆ Elevating by vertically extending the foundation walls of the home.

Activities that result in the construction of new living space at or above the BFE will only be considered when consistent with the Mitigation Reconstruction requirements. This includes structure elevations that abandon the lower enclosed area and add a new second story above the BFE to an existing structure. Such activities are only eligible under SRL. For additional information about mitigation reconstruction projects, see Part IX D.

The actual method selected for elevating a specific house will depend upon a number of factors such as:

- ◆ Foundation type;
- ◆ Condition of the house;
- ◆ Applicable State and local building codes;
- ◆ Soil type and bearing capacity;
- ◆ Weight of the house and lateral forces on the house from water and other natural hazards such as winds and earthquakes;
- ◆ Height of proposed elevation above the grade level; and
- ◆ Number of additions to the original structure.

The most common foundation types include:

- 
- ◆ Crawl space on foundation walls;
  - ◆ Slab-on-grade;
  - ◆ Open type foundation:
    - Piles; and
    - Posts or piers.

Additional details to consider when constructing an elevation project can be found in the following publications:

- ◆ FEMA 55, *Coastal Construction Manual*, May 2000;
- ◆ FEMA 259, *Engineering Principles and Practices of Retrofitting Floodprone Structures*, June 2001;
- ◆ FEMA 499, *Home Builders Guide to Coastal Construction Technical Fact Sheet Series*; and
- ◆ ASCE/SEI 24-05.

This is not an all-inclusive list of publications on retrofitting and elevations. More documents are available at: <http://www.fema.gov/rebuild/buildingscience/publications.shtm>.

### ***E.3 Eligible Structure Elevation Costs***

#### **E.3.1 Eligible Costs**

Allowable costs are those costs that are necessary and reasonable for the proper and efficient performance and administration of the Federal award. In addition to the costs identified in Part IV H.3, Cost Estimate, the following costs associated with structure elevation projects are generally allowable:

- ◆ Engineering services for design, structural feasibility analysis, and cost estimate preparation;
- ◆ Surveying, soil sampling, completion of elevation certificate, title search, deed recordation fees, legal and/or permitting fees, project administration, and construction management;
- ◆ Disconnection of all utilities;
- ◆ Building of a foundation so that the lowest floor is at the BFE, or higher if required by local ordinance or FEMA;
- ◆ Physical elevation of the structure and subsequent lowering and attachment of the structure onto a new foundation;
- ◆ A floor system that meets minimum building code requirements when the existing floor system cannot be elevated or is not appropriate for the new foundation;
- ◆ Reconnecting of utilities and extending lines and pipes as necessary and elevating all utilities and service equipment;
- ◆ Debris disposal and erosion control;

- 
- ◆ Costs for repair of lawns, landscaping, sidewalks, and driveways if damaged by elevation activities;
  - ◆ Construction of a utility room above the BFE may be eligible only if there is no existing space within the house for this purpose, or if there is no alternative cost-effective way to elevate the utilities;
  - ◆ Elevation of existing decks, porches, or stairs;
  - ◆ Construction of new stairs and railings to access the elevated living space per minimum code or local ordinance;
  - ◆ In a case where an owner or members of the owner's family have a permanent physical handicap, a physician's written certification is required before handicapped access facilities can be allowed as an eligible cost. Only one ADA-compliant access is allowable for funding unless specified otherwise in applicable State or local codes (for more information on ADA see: <http://www.ada.gov/>). If ramps are not technically feasible to build, a mechanical chair lift may be installed;
  - ◆ Documented reasonable living expenses (except food and personal transportation) that are incurred during the period when the owner is displaced by the elevation construction;
  - ◆ Abatement of asbestos and lead-based paint; and
  - ◆ Filling basements with compacted clean fill.

### **E.3.2 Ineligible Costs**

Certain structure elevation activities and their associated costs are not eligible. In addition to those activities listed as ineligible in Part III D.2, Ineligible Activities, ineligible costs for structure elevation also include, but are not limited to, the following:

- ◆ Elevating structures that were not in compliance with current NFIP standards at the time of construction;
- ◆ Costs related to building additions or auxiliary structures;
- ◆ Construction of new decks or porches;
- ◆ Any improvements for purely aesthetic reasons unless required by the EHP compliance review;
- ◆ Costs to replace or repair utility service components, which are undersized, inadequately designed, or unsafe;
- ◆ Exterior finish on the exposed foundation of the elevated building, unless required by EHP compliance review; and
- ◆ Additional landscaping for ornamentation beyond what existed on the site prior to construction of the project (e.g., trees, shrubs).

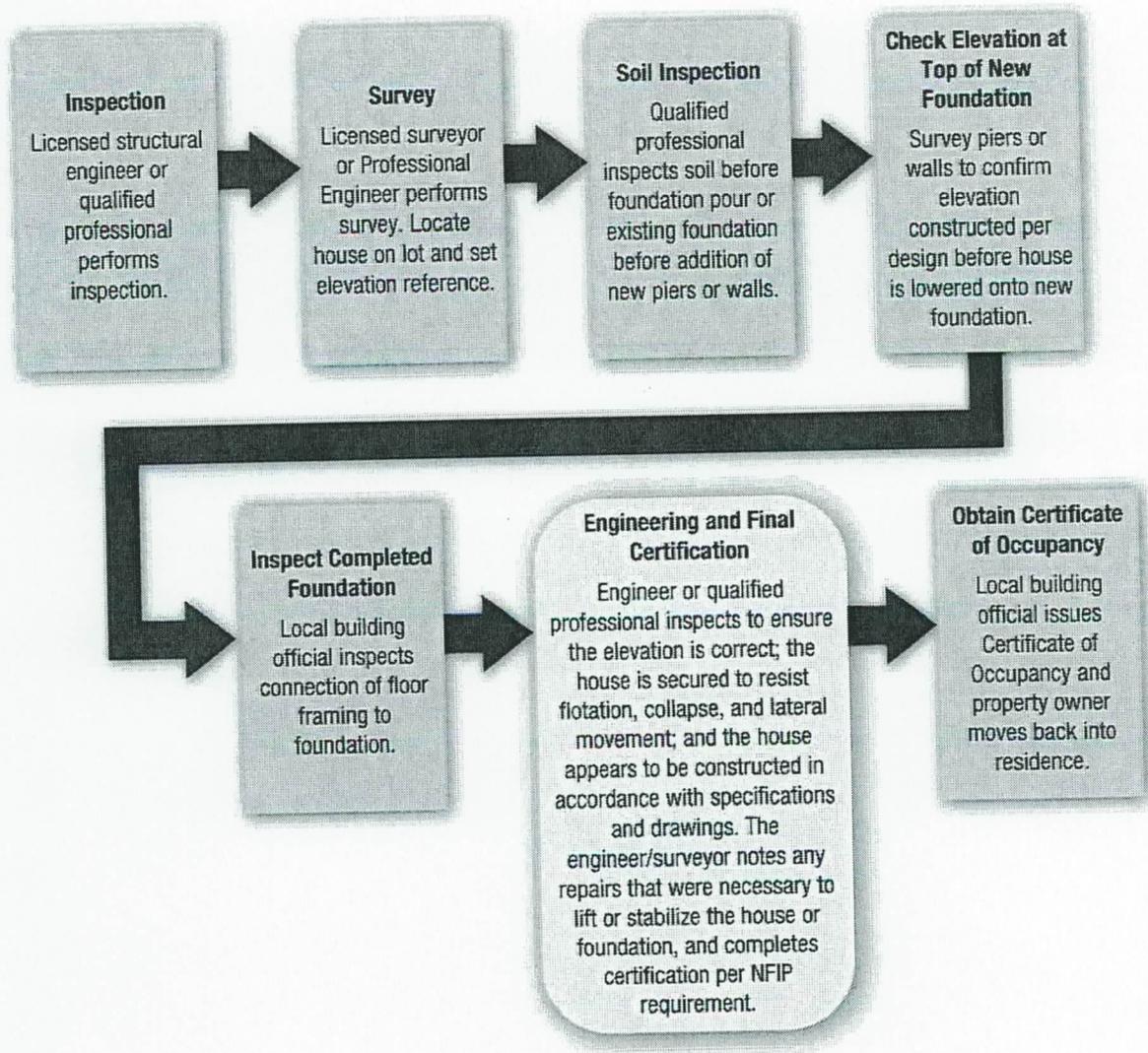
### ***E.4 Additional Application Requirements***

In addition to the items identified in Part IV H.1, Scope of Work, the following data is required for each structure:

- 
- ◆ Physical address and property owner's name;
  - ◆ The estimated cost to elevate each structure;
  - ◆ Name and location of flooding source (i.e., creek, river, watershed, or location of stormwater ponding) and location on the applicable FIRM;
  - ◆ The proposed elevation of the lowest floor for each structure to be mitigated, the BFE, and the current elevation of the lowest finished floor;
  - ◆ Type of existing foundation (slab-on-grade, crawl space, basement, or open foundation) and the proposed elevation method and standard to be used; and
  - ◆ A statement that the project will be designed in compliance with NFIP standards as outlined in 44 CFR Part 60.

### ***E.5 Survey and Inspection Considerations***

Surveying and inspections are encouraged throughout the construction process. Certifications of the surveys ensure the work has been performed in compliance with the structure-specific plans and specifications, applicable codes and standards, and minimum NFIP requirements. Figure 1 identifies important inspection and survey considerations.



**Figure 1: Inspections and Surveys**

### ***E.6 Closeout***

In addition to the typical HMA closeout processes, closeout of structure elevation projects generally includes:

- ◆ Update of the property site information in the eGrants database for each structure;
- ◆ A Certificate of Occupancy for each structure in the project to certify that the structure is code-compliant;
- ◆ A Final Elevation Certificate (FEMA Form 81-31) for each structure to ensure the structure has been elevated to the proper elevation;
- ◆ A copy of the recorded deed amendment for each property as required by Part III D.7.1 of this guidance;

- 
- ◆ Certification by an engineer, floodplain manager, or senior local official that the completed structure elevation is in compliance with local ordinances and NFIP regulations, including all applicable NFIP Technical Bulletins;
  - ◆ A front, rear, and side photograph of the final elevated structure; and
  - ◆ Verification of flood insurance for each structure.