

VULNERABILITY FLOOD STANDARDS

VF-1 Derivation of Residential Structure Flood Vulnerability Functions

- A. Development of the residential structure flood vulnerability functions shall be based on at least one of the following: (1) historical data, (2) tests, (3) rational structural analysis, and (4) site inspections. Any development of the residential structure flood vulnerability functions based on rational structural analysis, site inspections, and tests shall be supported by historical data.***
- B. The method of derivation of the residential structure flood vulnerability functions and their associated uncertainties shall be theoretically sound and consistent with fundamental engineering principles.***
- C. Residential building stock classification shall be representative of Florida construction for personal residential properties.***
- D. Residential structure primary construction material, height/number of stories, year of construction, location, building code, square footage of living area, and other construction characteristics, as applicable, shall be used in the derivation and application of residential structure flood vulnerability functions.***
- E. Flood vulnerability functions shall be separately derived for personal residential building structures, mobile homes, and appurtenant structures.***
- F. Residential structure flood vulnerability functions shall include damage as attributable to still flood water height, duration of the flood event (time needed for flood waters to recede), flood water velocity, wave action, impact of flood debris, and flood erosion and scour.***

Purpose: The development of residential structure flood vulnerability functions shall not be based exclusively on rational structural analysis or site inspections. Use of rational structural analysis or site inspections shall be supported by tests and historical data, and their use shall be appropriate.

The development of residential structure flood vulnerability functions shall be documented with respect to the methods and sources, including data, structural analysis and calculations, and site inspections.

Building codes and their enforcement affect the residential structure flood vulnerability functions.

Insurance company data used in residential structure flood vulnerability function development may include appropriate insurer or modeling organization adjustments that do not diminish the usefulness of the data.

Relevant Forms: GF-4, Vulnerability Flood Standards Structural/Wind Engineer Expert Certification
VF-1, One Hypothetical Flood Event
AF-6, Logical Relationship to Flood Risk (Trade Secret item)

Disclosures

1. Provide a flow chart documenting the process by which the residential structure flood vulnerability functions are derived and implemented.
2. Describe the nature and extent of actual insurance claims data used to develop the flood model's residential structure flood vulnerability functions. Describe in detail what is included, such as, number of policies, number of insurers, date of loss, and number of units of dollar exposure, separated into personal residential and mobile home.
3. Describe the research, data, methods, and processes used for the development of the residential structure flood vulnerability functions.
4. Summarize site inspections, including the source, and provide a brief description of the resulting use of these data in development, validation, or verification of residential structure flood vulnerability functions.
5. Describe the residential building stock classification and the categories of the different residential structure flood vulnerability functions. Specifically, include descriptions of the building primary construction material and characteristics, building height, number of stories, regions within the state of Florida including designated flood zones (e.g., FEMA), year of construction, and occupancy types in which a unique residential structure flood vulnerability function is used. Provide the total number of residential structure flood vulnerability functions available for use in the flood model for personal residential structures in Florida.
6. Describe the process by which local construction practices and building code adoption and enforcement are considered in the flood model.
7. Describe the development of the flood vulnerability functions for appurtenant structures.
8. Describe the relationship between residential structure and appurtenant structure flood vulnerability functions and their consistency with insurance claims data.
9. Describe the assumptions, data, methods, and processes used to develop residential structure flood vulnerability functions for unknown personal residential construction types and for when some primary characteristics are unknown.

10. Describe the assumptions, data, methods, and processes used to develop residential structure flood vulnerability functions for various construction types for renters and condo-unit owners.
11. Describe any assumptions, data, methods, and processes used to develop and validate residential structure flood vulnerability functions concerning insurance company claims.
12. Describe how the duration of a flood is considered.
13. Describe how the flood model addresses depth of flood, impact by flood water, wave action, and flood induced debris impact damage.
14. Describe how the residential structure vulnerability functions for storm surge are developed.
15. Provide a completed Form VF-1, One Hypothetical Flood Event. Provide a link to the location of the form [insert hyperlink here]. [form to be developed]

Audit

1. The residential structure flood vulnerability component in the flood model will be reviewed in detail.
2. Historical data shall be available in the original form with explanations for any changes made and descriptions of how missing or incorrect data were handled. For historical data used to develop residential structure flood vulnerability functions, demonstrate the goodness-of-fit of the data. Complete reports detailing flooding conditions and damage suffered are required for any test data used. Complete rational structural analyses and calculations shall be presented so that a variety of different residential structure classes may be selected for review. Original site inspection reports shall be available for review.
3. Copies of any papers, reports, and studies used in the development of the residential structure flood vulnerability functions shall be available for review.
4. Multiple samples of residential structure flood vulnerability functions for personal residential structures, mobile homes, and appurtenant structures shall be available for review. The magnitude of logical changes among these items for given flood events shall be explained and validation materials shall be available.
5. Justify the residential structures construction classes and characteristics used.
6. Provide validation of the mean residential structure flood vulnerability functions and associated uncertainties.
7. Document and justify all modifications to the residential structure flood vulnerability functions due to building codes and their enforcement. If age of residential structure

is used as a surrogate for building code and code enforcement, provide complete supporting information for the number of age groups used as well as the year(s) of construction that separates particular group(s).

8. The effects on residential structure flood vulnerability from local and regional construction characteristics and building codes will be reviewed.
9. Describe how the claim practices of insurance companies are accounted for when claims data for those insurance companies are used to develop or to verify residential structure flood vulnerability functions. Examples include the level of damage the insurer considers a loss to be a total loss, claim practices of insurers with respect to concurrent causation, or the impact of public adjusting.
10. Provide the percentage of damage at or above which the flood model assumes a total loss.
11. Form VF-1 (One Hypothetical Flood Event) will be reviewed.

VF-2 Derivation of Contents and Time Element Flood Vulnerability Functions

- A. Development of the contents and time element flood vulnerability functions shall be based on at least one of the following: (1) historical data, (2) tests, (3) rational structural analysis, and (4) site inspections. Any development of the contents and time element vulnerability functions based on rational structural analysis, site inspections, and tests shall be supported by historical data.***
- B. The relationship between the modeled residential structure and contents flood vulnerability functions and historical residential structure and contents losses shall be reasonable.***
- C. Time element flood vulnerability function derivations shall consider the estimated time required to repair or replace the property.***
- D. The relationship between the modeled residential structure and time element flood vulnerability functions and historical residential structure and time element losses shall be reasonable.***
- E. Time element flood vulnerability functions used by the flood model shall include time element coverage claims associated with damage to the infrastructure caused by a flood.***

Purpose: A reasonable representation of contents and time element flood losses is necessary in order to address policies that cover contents and time element losses.

Policies can provide varying types of time element coverage and insurance policies may pay for time element claims irrespective of flood damage to the insured property.

Relevant Form: GF-4, Vulnerability Flood Standards Structural/Wind Engineer
Expert Certification

Disclosures

1. Provide a flow chart documenting the process by which the contents flood vulnerability functions are derived and implemented.
2. Describe the data and methods used to develop flood vulnerability functions for contents coverage associated with personal residential structures.

3. Describe the number of contents flood vulnerability functions and whether different contents flood vulnerability relationships are used for personal residential structures, mobile home, condo unit owners, and apartment renter unit location.
4. Provide a flow chart documenting the process by which the time element flood vulnerability functions are derived and implemented.
5. Describe the data and methods used to develop flood vulnerability functions for time element coverage associated with personal residential structures. State whether the flood model considers both direct and indirect loss to the insured property and explain how each is derived.
6. State the minimum threshold at which time element flood loss is calculated (e.g., loss is estimated for residential structure damage greater than 20%). Provide documentation of validation results to verify the approach used.
7. Describe how modeled time element flood loss costs take into consideration the damage to local and regional infrastructure due to flood events.
8. Describe the relationship between residential structure and contents flood vulnerability functions.
9. Describe the relationship between residential structure and time element flood vulnerability functions.
10. Describe the assumptions, data, methods, and processes used to develop contents and time element flood vulnerability functions for unknown personal residential construction types and for when some primary characteristics are unknown.
11. Describe any assumptions, data, methods, and processes used to develop and validate contents and time element flood vulnerability functions concerning insurance company claims.
12. Demonstrate that contents and time element flood vulnerability function relationships are consistent with insurance claims data.

Audit

1. The contents and time element flood vulnerability component in the flood model will be reviewed in detail.
2. To the extent that historical data are used to develop mathematical depictions of contents flood vulnerability functions, demonstrate the goodness-of-fit of the data to fitted models.

3. Documentation and justification of the following will be reviewed:
 - a. The method of derivation and data on which the contents flood vulnerability functions are based;
 - b. Assumptions regarding the variability of contents flood losses by size of property;
 - c. Regional and statewide application of contents flood coverage assumptions;
 - d. Assumptions regarding contents flood coverage for various occupancies including mobile homes, tenants, and condo unit owners exposure;
4. To the extent that historical data are used to develop mathematical depictions of time element flood vulnerability functions, demonstrate the goodness-of-fit of the data to fitted flood models.
5. Documentation and justification of the following will be reviewed:
 - a. The method of derivation and data on which the time element flood vulnerability functions are based;
 - b. Assumptions regarding the variability of time element flood losses by size of property;
 - c. Regional and statewide application of time element flood coverage assumptions;
 - d. Assumptions regarding time element flood coverage for various occupancies including mobile homes, tenants, and condo unit owners exposure;
 - e. The methods used to incorporate the estimated time required to repair or replace the property due to flooding;
 - f. The methodology and available validation for determining the extent of infrastructure flood damage and its effect on time element costs.

VF-3 Flood Mitigation Measures

A. Modeling of flood mitigation measures to improve a residential structure's flood resistance and the corresponding effects on vulnerability shall be theoretically sound and consistent with fundamental engineering principles. These measures shall include fixtures or construction techniques that enhance the performance of the residential structure and its contents and shall consider:

- **Wall-to-floor-to-foundation strength and anchorage**
- **Opening protection and seepage control**
- **On-site flood mitigation measures associated with either the structure or the property (e.g., seawalls, floodwalls, retention ponds, water barriers, etc.)**
- **Elevation from ground surface of first level of living area**
- **Electrical outlets and mechanical equipment above regulatory flood levels or appropriately flood proofed**
- **Restrict use of construction materials that deteriorate when wetted (moistened) as a result of flooding**
- **Design of exterior walls and siding to withstand water pressure, flood water and debris impact, and wave loading**
- **Use of ceramic tiles, concrete versus carpet and wood for floor covering**
- **Lack of basements.**

B. Application of flood mitigation measures that enhance the performance of the residential structure and its contents shall be justified as to the impact on reducing flood damage whether done individually or in combination.

Purpose: Mitigation techniques and approaches to eliminate or reduce flood losses must be accounted for in the flood model as they impact the residential exposures in the state of Florida.

It is necessary to account for the total impact that the use of multiple flood mitigation measures will have on flood damage. When multiple flood mitigation measures are used, the effect on flood damage may not be the sum of the effects of the individual measures.

Relevant Forms: GF-4, Vulnerability Flood Standards Structural/Wind Engineer
Expert Certification
VF-2, Flood Mitigation Measures – Range of Changes in Flood Damage
VF-3, Flood Mitigation Measures – Mean Flood Damage Ratios and
Flood Loss Costs (Trade Secret item)
AF-6, Logical Relationship to Flood Risk (Trade Secret item)

Disclosures

1. Provide a completed Form VF-2, Flood Mitigation Measures – Range of Changes in Flood Damage. Provide a link to the location of the form [insert hyperlink here]. [form to be developed]
2. A completed Form VF-3, Flood Mitigation Measures – Mean Flood Damage Ratios and Flood Loss Costs (Trade Secret item) [form to be developed] shall be provided during the closed meeting portion of the Commission meeting to review the model for acceptability.
3. Provide a description of the flood mitigation measures used by the flood model that are not listed in Form VF-2, Flood Mitigation Measures – Range of Changes in Flood Damage.
4. Describe how flood mitigation is implemented in the flood model. Identify any assumptions.
5. Describe the process used to ensure that multiple flood mitigation factors are correctly combined in the flood model.
6. Describe how structural flood mitigation factors are accounted for in the flood model. Identify any assumptions.
7. Describe how contents flood mitigation factors are accounted for in the flood model. Identify any assumptions.
8. Describe how flood mitigation measures impact time element losses.

Audit

1. Form VF-2 (Flood Mitigation Measures – Range of Changes in Flood Damage) and Form VF-3 (Flood Mitigation Measures – Mean Flood Damage Ratios and Flood Loss Costs, Trade Secret item) provide the information used in auditing this standard.
2. Individual flood mitigation measures as well as their effect on flood damage due to use of multiple flood mitigation measures will be reviewed. Any variation in the change over the range of flood footprints for individual and multiple flood mitigation measures will be reviewed.
3. Flood Mitigation measures used by the flood model that are not listed as required in this flood standard will be disclosed and shown to be theoretically sound and reasonable.
4. Flood mitigation measures used by the flood model for structural, contents, and time element losses will be reviewed.

Form VF-1: One Hypothetical Flood Event

[Create form for a flood event – seeking public input]

**Form VF-2: Flood Mitigation Measures –
Range of Changes in Flood Damage**

[Create Form for impact of flood mitigation measures – seeking public input]

**Form VF-3: Flood Mitigation Measures – Mean Flood Damage Ratios
and Flood Loss Costs (Trade Secret Item)**

[Create Form for impact of flood mitigation measures – seeking public input]