

VULNERABILITY FLOOD STANDARDS

VF-1 Derivation of Residential Structure and Contents Flood Vulnerability Functions

- A. Specification of the residential structure and contents flood vulnerability functions shall be based on some combination of the following: (1) rational structural analysis, (2) post-flood site inspections, (3) technical literature, (4) expert opinion, (5) physical testing, and (6) insurance claims data. Residential structure and contents flood vulnerability functions shall be supported by historical data.*
- B. The method of derivation of the residential 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. The following flood characteristics shall be used in the derivation of residential structure and contents flood vulnerability functions: flood elevation and depth above ground, and wave action in coastal areas.*
- E. The following building characteristics shall be used or accounted for in the derivation of residential structure and contents vulnerability functions: lowest floor elevation relative to ground, foundation type, primary construction materials, year of construction, and location (flood hazard zone).*
- F. Flood vulnerability functions shall be separately derived for personal residential building structures, mobile homes, and appurtenant structures.*
- G. The relationship between the modeled residential structure and contents flood vulnerability functions and historical residential structure and contents losses shall be justified.*

Purpose: Residential structure and contents flood vulnerability functions are to account for both flood and building characteristics. This standard requires the development of residential flood vulnerability functions to be supported by historical data.

The development of residential flood vulnerability functions are to be documented with respect to the methods and sources, including any use of insurance claims data, structural analysis and calculations, post-flood site

inspections, physical testing, expert opinion, and technical literature. Flood vulnerability functions are to be supported by historical data.

This standard allows insurance company data used in residential flood vulnerability function development to include appropriate insurer or modeling organization adjustments that do not diminish the usefulness of the data.

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

Disclosures

1. Provide flow charts documenting the process by which the residential structure and contents flood vulnerability functions are derived and implemented.
2. As applicable, describe the nature and extent of actual insurance claims data used to develop the flood model's residential structure and contents 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 and contents flood vulnerability functions.
4. Describe the relationship between residential structure and contents flood vulnerability functions.
5. 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 and contents flood vulnerability functions.
6. State if the following flood characteristics are considered in the development of the residential structure and contents vulnerability functions, and if so, how; if not, explain why: flood velocity, flood-induced erosion, flood-borne debris, salinity (saltwater versus freshwater flooding), flood duration, and likelihood of mold following flooding.
7. State if the following building characteristics are considered in the development of the residential structure and contents vulnerability functions, and if so, how; if not, explain why: number of stories, use of each story (e.g., habitable space, parking, storage, other), presence of basement, replacement value of building, structure and contents value by story, square footage of living area, and other construction characteristics, as applicable.

8. Describe the process by which local construction practices, building code, and floodplain management regulation adoption and enforcement are considered in the development of residential flood vulnerability functions.
9. Describe the development of the flood vulnerability functions for appurtenant structures.
10. Describe the relationship between residential structure and appurtenant structure flood vulnerability functions and their consistency with insurance claims data as applicable.
11. Describe the assumptions, data, methods, and processes used to develop residential structure and contents flood vulnerability functions for unknown personal residential construction types and for when some primary characteristics are unknown.
12. Describe the assumptions, data, methods, and processes used to develop residential structure and contents flood vulnerability functions for various construction types for renters and condo-unit owners.
13. As applicable, describe any assumptions, data, methods, and processes used to develop and validate residential structure and contents flood vulnerability functions concerning insurance company claims.
14. Describe how the duration of a flood is considered. Include consideration of time after flooding before building access and cleanup can begin, and the likelihood of mold after flooding.
15. Describe how the residential structure and contents flood vulnerability functions incorporate depth of flooding (above ground and above lowest floor), flood velocity, wave action (in coastal areas), undermining by erosion or scour, flood-borne debris, and salinity of floodwater.
16. Describe how the residential structure and contents vulnerability functions are developed for coastal and inland flooding.
17. Provide a completed Form VF-1, **XX** Hypothetical Flood Events. Provide a link to the location of the form [insert hyperlink here]. **[form to be developed]**

Audit

1. The residential structure and contents flood vulnerability components 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 and contents 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. Other technical literature and expert opinion summaries will be reviewed.
3. Copies of any papers, reports, and studies used in the development of the residential structure and contents flood vulnerability functions shall be available for review.
 4. Multiple samples of residential structure and contents 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. Justification of the residential structures construction classes and characteristics used will be reviewed.
 6. Validation of the residential structure and contents flood vulnerability functions and associated uncertainties will be reviewed.
 7. Documentation and justification for all modifications to the residential structure flood vulnerability functions due to building codes and their enforcement will be reviewed. If age of residential structure is used as a surrogate for building code or floodplain management regulation, complete supporting information for the number of age groups used as well as the year(s) of construction that separates particular group(s) will be reviewed.
 8. The effects on residential structure flood vulnerability from local and regional construction characteristics and building codes will be reviewed.
 9. 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 and contents flood vulnerability functions will be reviewed. 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. The percentage of damage at or above which the flood model assumes a total structure loss and total contents loss will be reviewed.
 11. Documentation and justification for the method of derivation and data on which the structure and contents flood vulnerability functions are based will be reviewed.
 12. Documentation and justification for the variability of contents flood losses by size of property will be reviewed.
 13. Form VF-1 (XX Hypothetical Flood Events) 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]