**Vulnerability Standards**

**V-1 Derivation of Building Hurricane Vulnerability Functions**

1. ***Development of the building hurricane vulnerability functions shall be based on at least one of the following: (1) insurance claims data, (2) laboratory or field testing, (3) rational structural analysis, and (4) post-event site investigations. Any development of the building hurricane vulnerability functions based on rational structural analysis, post-event site investigations, and laboratory or field testing shall be supported by historical data.***
2. ***The derivation of the building hurricane vulnerability functions and their associated uncertainties shall be theoretically sound and consistent with fundamental engineering principles.***
3. ***Residential building stock classification shall be representative of Florida construction for personal and commercial residential buildings.***
4. ***Building height/number of stories, primary construction material, year of construction, location, building code, and other construction characteristics, as applicable, shall be used in the derivation and application of building hurricane vulnerability functions.***

1. ***Hurricane vulnerability functions shall be separately derived for commercial residential building structures, personal residential building structures, manufactured homes, and appurtenant structures.***
2. ***The minimum windspeed that generates damage shall be consistent with fundamental engineering principles.***
3. ***Building hurricane vulnerability functions shall include damage as attributable to windspeed and wind pressure, water infiltration, and missile impact associated with hurricanes. Building hurricane vulnerability functions shall not include explicit damage to the building due to flood, storm surge, or wave action.***

Suggestion from Commissioner Lee:

**Explanation:** Indicate requirement of data to modify if data is not available.

**Amendatory Language:**

A. Development of the building vulnerability functions shall be based on at least one of the following: (1) insurance claims data, (2) laboratory or field testing, (3) rational structural analysis, and (4) post-event site investigations. Any development of the building hurricane vulnerability functions based on rational structural analysis, post-event site investigations, and laboratory or field testing shall be supported by historical data unless not available.

Purpose: Both hurricane and building characteristics affect personal and commercial residential building hurricane vulnerability functions.

The data and methods used to develop building hurricane vulnerability functions, and their associated uncertainties, affect the modeled hurricane loss costs and hurricane probable maximum loss levels. Their development and documentation are essential parts of the hurricane model.

 The adoption and enforcement of building codes affect the building hurricane vulnerability functions.

Suggestion from Commissioner Lee:

**Explanation:** Emphasis on building code that statewide and local be reflected.

**Amendatory Language:**

The adoption and enforcement of statewide and local building codes affect the building hurricane vulnerability functions.

 The design methods, applicable building codes, and construction practices may differ significantly for commercial residential building structures, personal residential building structures, manufactured homes, and appurtenant structures.

Damage certainly occurs above the hurricane threshold of 74 mph, but can also occur for windspeeds well below this threshold.

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Relevant Forms: G-4, Vulnerability Standards Expert Certification

 V-1, One Hypothetical Event

 A-1, Zero Deductible Personal Residential Hurricane Loss Costs by ZIP Code

 A-6, Logical Relationship to Risk (Trade Secret item)

**Disclosures**

1. Describe any modifications to the building vulnerability component in the hurricane model since the previously-accepted hurricane model.
2. Provide a flowchart documenting the process by which the building hurricane vulnerability functions are derived and implemented.
3. Describe the nature and extent of actual insurance claims data used to develop the building hurricane vulnerability functions. Describe in detail what is included, such as, number of policies, number of insurers, dates of hurricane loss, and number of units of dollar exposure, separated into personal residential, commercial residential, and manufactured homes.
4. Describe the assumptions, data (including insurance claims data), methods, and processes used for the development of the building hurricane vulnerability functions.
5. Summarize post-event site investigations, including the sources, and provide a brief description of the resulting use of these data in the development or validation of building hurricane vulnerability functions.
6. Describe the categories of the different building hurricane vulnerability functions. Specifically, include descriptions of the building types and characteristics, building height, number of stories, regions within the state of Florida, year of construction, and occupancy types for which a unique building hurricane vulnerability function is used. Provide the total number of building hurricane vulnerability functions available for use in the hurricane model for personal and commercial residential classifications.
7. Describe the process by which local construction practices and building code adoption and enforcement are considered in the development of the building hurricane vulnerability functions.

Suggestion from Commissioner Lee:

**Explanation:** Emphasis on building code that statewide and local be reflected.

**Amendatory Language:**

7. Describe the process by which local construction practices and statewide and local building code adoption and enforcement are considered in the development of the building hurricane vulnerability functions.

1. Describe the relationship between building structure and appurtenant structure hurricane vulnerability functions and their consistency with insurance claims data.
2. Describe the assumptions, data (including insurance claims data), methods, and processes used to develop building hurricane vulnerability functions when:
3. residential construction types are unknown,
4. one or more primary building characteristics are unknown,
5. one or more secondary characteristics are known, and
6. building input characteristics are conflicting.
7. Identify the one-minute average sustained windspeed and the windspeed reference height at which the hurricane model begins to estimate damage.
8. Describe how the duration of windspeeds at a particular location over the life of a hurricane is considered.
9. Describe how the hurricane model addresses wind-borne missile impact damage and water infiltration.
10. Provide a completed Form V-1, One Hypothetical Event. Provide a link to the location of the form [insert hyperlink here].

**Audit**

1. Modifications to the building vulnerability component in the hurricane model since the previously-accepted hurricane model will be reviewed in detail, including the rationale for the modifications, the scope of the modifications, the process, the resulting modifications and their impacts on the building vulnerability component. Comparisons with the previously-accepted hurricane model will be reviewed.

2. Historical data in the original form will be reviewed with explanations for any changes made and descriptions of how missing or incorrect data were handled. When historical data is used to develop building hurricane vulnerability functions, the goodness-of-fit of the data will be reviewed. Complete reports detailing loading conditions and damage states for any laboratory or field testing data used will be reviewed. When rational structural analysis is used to develop building hurricane vulnerability functions, such analyses will be reviewed for a variety of different building construction classes. Laboratory or field tests and original post-event site investigation reports will be reviewed.

1. All papers, reports, and studies used in the continual development of the building hurricane vulnerability functions must be available for review in hard copy or electronic form.
2. Multiple samples of building hurricane vulnerability functions for commercial residential building structures, personal residential building structures, manufactured homes, and appurtenant structures will be reviewed. The magnitude of logical changes among these items for a given windspeed and validation materials will be reviewed.
3. Justification for the construction classes and characteristics used will be reviewed.
4. Validation of the building hurricane vulnerability functions and associated uncertainties will be reviewed.
5. Documentation and justification for all modifications to the building hurricane vulnerability functions due to building codes and their enforcement will be reviewed. If year of construction and/or geographical location of building is used as a surrogate for building code and code enforcement, complete supporting information for the number of year of construction groups used as well as the year(s) and/or geographical region(s) of construction that separates particular group(s) will be reviewed.

Suggestion from Commissioner Lee:

**Explanation:** Emphasis on building code that statewide and local be reflected.

**Amendatory Language:**

7. Documentation and justification for all modifications to the building hurricane vulnerability functions due to statewide and local building codes and their enforcement will be reviewed. If year of construction and/or geographical location of building is used as a surrogate for building code and code enforcement, complete supporting information for the number of year of construction groups used as well as the year(s) and/or geographical region(s) of construction that separates particular group(s) will be reviewed.

1. Validation material for the disclosed minimum windspeed will be reviewed. The computer code showing the inclusion of the minimum windspeed at which damage occurs will be reviewed.
2. The effects on building hurricane vulnerability from local and regional construction characteristics and building codes will be reviewed.

Suggestion from Commissioner Lee:

**Explanation:** Emphasis on building code that statewide and local be reflected and if current building codes are reflected.

**Amendatory Language:**

 9. The effects on building hurricane vulnerability from local and regional construction characteristics and statewide and local building codes will be reviewed including whether current building codes are reflected.

1. How the claim practices of insurance companies are accounted for when claims data for those insurance companies are used to develop or to verify building hurricane 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.
2. The percentage of damage at or above which the hurricane model assumes a total structure loss will be reviewed.
3. A plot comparing building structure and appurtenant structure hurricane vulnerability functions will be reviewed.

Suggestion from RMS:

**Problem Statement:** Plots of building and appurtenant structure vulnerability, as prescribed in Standard V-1, Audit Item 12, may not be instructive.

**Explanation:** Editorial proposal to raise that plots of building and appurtenant structure relativity may be too specific in some cases and therefore not instructive; a general review of this relativity may be more useful.

**Amendatory Language:**

12. Building structure and appurtenant structure hurricane vulnerability functions will be compared.

1. A plot comparing appurtenant structure hurricane vulnerability functions with insurance claims data will be reviewed.
2. Form V-1, One Hypothetical Event, will be reviewed.

**V-2 Derivation of Contents and Time Element Hurricane Vulnerability Functions\***

 *(\*Significant Revision)*

1. ***Development of the contents and time element hurricane vulnerability functions shall be based on at least one of the following: (1) insurance claims data, (2) tests, (3) rational structural analysis, and (4) post-event site investigations. Any development of the contents and time element hurricane vulnerability functions based on rational structural analysis, post-event site investigations, and tests shall be supported by historical data.***
2. ***The relationship between the modeled building and contents hurricane vulnerability functions and historical building and contents hurricane losses shall be reasonable.***
3. ***Time element hurricane vulnerability function derivations shall consider the estimated time required to repair or replace the property.***
4. ***The relationship between the hurricane model building, contents, and time element hurricane vulnerability functions and historical building, contents, and time element hurricane losses shall be reasonable.***
5. ***Time element hurricane vulnerability functions used by the hurricane model shall include time element hurricane losses associated with wind, missile impact, flood, and storm surge damage to the infrastructure caused by a hurricane.***

Purpose: Contents and time element hurricane vulnerability functions and hurricane losses are affected by various hurricane, contents, and building characteristics.

 Historical contents and time element hurricane loss data are a reasonable indicator of the appropriateness of contents and time element hurricane vulnerability functions.

 The documentation of the development of contents and time element hurricane vulnerability functions with respect to the methods and sources, including any use of insurance claims data (including any adjustments), post-event site investigations, rational structural analysis, and testing data and reports, support the appropriateness of the contents and time element hurricane vulnerability functions.

 A reasonable representation of contents and time element hurricane vulnerability is necessary in order to address policies that cover contents and time element hurricane losses.

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

 Relevant Forms: G-4, Vulnerability Standards Expert Certification

 A-6, Logical Relationship to Risk (Trade Secret item)

**Disclosures**

1. Describe any modifications to the contents and time element vulnerability component in the hurricane model since the previously-accepted hurricane model.
2. Provide a flowchart documenting the process by which the contents hurricane vulnerability functions are derived and implemented.
3. Describe the assumptions, data (including insurance claims data), methods, and processes used to develop and validate the contents hurricane vulnerability functions.
4. Provide the total number of contents hurricane vulnerability functions. Describe whether different contents hurricane vulnerability functions are used for personal residential, commercial residential, manufactured homes, unit location for condo owners and apartment renters, and various building classes.
5. Provide a flowchart documenting the process by which the time element hurricane vulnerability functions are derived and implemented.
6. Describe the assumptions, data (including insurance claims data), methods, and processes used to develop and validate the time element hurricane vulnerability functions.
7. Describe how time element hurricane vulnerability functions take into consideration the damage (including damage due to storm surge, flood, and wind) to local and regional infrastructure.
8. Describe the relationship between building structure and contents hurricane vulnerability functions.
9. Describe the relationship between building structure and time element hurricane vulnerability functions.
10. Describe the assumptions, data (including insurance claims data), methods, and processes used to develop contents and time element hurricane vulnerability functions when:
11. residential constructions types are unknown,
12. one or more primary characteristics are unknown,
13. one or more secondary characteristics are known, and
14. building input characteristics are conflicting.

**Audit**

1. Modifications to the contents and time element vulnerability component in the hurricane model since the previously-accepted hurricane model will be reviewed in detail, including the rationale for the modifications, the scope of the modifications, the process, the resulting modifications and their impact on the contents and time element vulnerability component. Comparisons with the previously-accepted hurricane model will be reviewed.
2. Multiple samples of contents and time element hurricane vulnerability functions will be reviewed.

3. To the extent that historical data are used to develop mathematical depictions of contents hurricane vulnerability functions, the goodness-of-fit of the data to fitted models will be reviewed.

4. Justification for changes from the previously-accepted hurricane model in the relativities between hurricane vulnerability functions for building and the corresponding hurricane vulnerability functions for contents will be reviewed.

5. Justification and documentation for the dependence of contents hurricane vulnerability functions on construction and occupancy type will be reviewed.

6. Documentation and justification of the following aspects or assumptions related to contents and time element hurricane vulnerability functions will be reviewed:

1. The method of derivation and underlying data,
2. Validation data specifically applicable to time element hurricane vulnerability,
3. Coding of time element by insurers,
4. The effects of demand surge on time element for the 2004 and 2005 hurricane seasons,
5. Variability of time element hurricane vulnerability by building classification and characteristics,
6. Statewide application of time element coverage,
7. Time element vulnerability for various occupancies,
8. The methods used to estimate the time, including uncertainty, required to repair or replace the property, and
9. The methodology and validation for determining the extent of infrastructure damage and their effect on time element hurricane vulnerability.

7. Justification for changes from the previously-accepted hurricane model in the relativities between hurricane vulnerability functions for building and the corresponding hurricane vulnerability functions for time element will be reviewed.

8. To the extent that historical data are used to develop mathematical depictions of time element hurricane vulnerability functions, the goodness-of-fit of the data to fitted models will be reviewed.

**V-3 Hurricane Mitigation Measures and Secondary Characteristics\***

*(\*Significant Revision)*

1. ***Modeling of hurricane mitigation measures to improve a building’s hurricane wind resistance, the corresponding effects on hurricane vulnerability, and their associated uncertainties shall be theoretically sound and consistent with fundamental engineering principles. These measures shall include fixtures or construction techniques that affect the performance of the building and the damage to contents and shall consider:***
* ***Roof strength***
* ***Roof covering performance***
* ***Roof-to-wall strength***
* ***Wall-to-floor-to-foundation strength***
* ***Opening protection***
* ***Window, door, and skylight strength.***

***The modeling organization shall justify all hurricane mitigation measures considered by the hurricane model.***

1. ***Application of hurricane mitigation measures that affect the performance of the building and the damage to contents shall be justified as to the impact on reducing damage whether done individually or in combination.***
2. ***Treatment of individual and combined secondary characteristics that affect the performance of the building and the damage to contents shall be justified.***

Comment from Commissioner Lee:

 I believe wood shutters are covered, but attached pdf of ARA study to make sure these categories are covered as one of the recent issues is discounts for wood shutters which is not included in the mitigation rule.

Purpose: Hurricane mitigation measures are intended to eliminate or reduce hurricane damage in the modeled hurricane losses as they impact the performance of personal and commercial residential buildings. Florida Statutes require rate filings to include, but not be limited to, the fixtures or construction techniques listed in this standard. Subsequent Florida Office of Insurance Regulation Informational Memorandum 02-0470M refers to a public domain study and further defines the items required:

1. Enhanced roof strength. Example: Braced gable end roof.
2. Enhanced roof covering performance. Example: Roof covering materials that comply with the current Florida Building Code.
3. Enhanced roof-to-wall strength. Example: Hurricane clips or straps, increased size or decreased spacing of nails in roof deck attachment.
4. Enhanced wall-to-floor-to-foundation strength. Example: Stronger anchor bolts or closer spacing of anchors.
5. Opening protection. Example: Shutter products.
6. Window, door (entry doors, garage doors, and sliding glass doors), and skylight strength. Example: Impact resistant glazing, entry doors, garage doors, and sliding glass doors of various strengths.

 Secondary characteristics are building characteristics in addition to primary characteristics that might affect building performance in a hurricane event. Secondary characteristics include, but are not limited to:

1. Roof shape – hip roof (sloping ends and sloping sides down to the roof eaves line).
2. Age of roof covering.
3. Wall construction – wood frame, unreinforced or reinforced masonry.
4. Opening protection for non-glazed openings – doors and garage doors.

Relevant Forms: G-4, Vulnerability Standards Expert Certification

 V-2, Hurricane Mitigation Measures and Secondary Characteristics, Range of Changes in Damage

 V-3, Hurricane Mitigation Measures and Secondary Characteristics, Mean Damage Ratios and Hurricane Loss Costs (Trade Secret Item)

V-4, Percentage Change in Hurricane Mitigation Measures and Secondary Characteristics

V-5, Percentage Change in Hurricane Mitigation Measures and Secondary Characteristics, Mean Damage Ratios and Hurricane Loss Costs

 A-6, Logical Relationship to Risk (Trade Secret item)

**Disclosures**

1. Describe any modifications to hurricane mitigation measures and secondary characteristics in the hurricane model since the previously-accepted hurricane model.

1. Provide a completed Form V-2, Hurricane Mitigation Measures and Secondary Characteristics, Range of Changes in Damage. Provide a link to the location of the form [insert hyperlink here].
2. Provide a description of the hurricane mitigation measures and secondary characteristics used by the hurricane model, whether or not they are listed in Form V-2, Hurricane Mitigation Measures and Secondary Characteristics, Range of Changes in Damage.

4. Describe how hurricane mitigation measures and secondary characteristics are implemented in the hurricane model. Identify any assumptions.

5. Describe how the effects of multiple hurricane mitigation measures and secondary characteristics are combined in the hurricane model and the process used to ensure that multiple hurricane mitigation measures and secondary characteristics are correctly combined.

6. Describe how building and contents damage are affected by performance of hurricane mitigation measures and secondary characteristics. Identify any assumptions.

7. Describe how hurricane mitigation measures and secondary characteristics affect the uncertainty of the vulnerability. Identify any assumptions.

8. Provide a completed Form V-4, Percentage Change in Hurricane Mitigation Measures and Secondary Characteristics. Provide a link to the location of the form [insert hyperlink here].

9. Provide a completed Form V-5, Percentage Change in Hurricane Mitigation Measures and Secondary Characteristics, Mean Damage Ratios and Hurricane Loss Costs. Provide a link to the location of the form [insert hyperlink here].

**Audit**

1. Modifications to hurricane mitigation measures and secondary characteristics in the hurricane model since the previously-accepted hurricane model will be reviewed in detail, including the rationale for the modifications, the scope of the modifications, the process, the resulting modifications, and their impacts on the vulnerability component. Comparisons with the previously-accepted hurricane model will be reviewed.
2. Form V-2, Hurricane Mitigation Measures and Secondary Characteristics, Range of Changes in Damage, Form V-3, Hurricane Mitigation Measures and Secondary Characteristics, Mean Damage Ratios and Hurricane Loss Costs (Trade Secret item), Form V-4, Percentage Change in Hurricane Mitigation Measures and Secondary Characteristics, and Form V-5, Percentage Change in Hurricane Mitigation Measures and Secondary Characteristics, Mean Damage Ratios and Hurricane Loss Costs, will be reviewed.
3. Implementation of individual hurricane mitigation measures and secondary characteristics will be reviewed as well as the effect of individual hurricane mitigation measures and secondary characteristics on damage. Any variation in the change over the range of windspeeds for individual hurricane mitigation measures and secondary characteristics will be reviewed. Historical data, technical literature, analysis or judgment based on fundamental engineering principles used to support the assumptions and implementation of the hurricane mitigation measures and secondary characteristics will be reviewed.
4. Implementation of multiple hurricane mitigation measures and secondary characteristics will be reviewed. The combined effects of these hurricane mitigation measures and secondary characteristics on damage will be reviewed. Any variation in the change over the range of windspeeds for multiple hurricane mitigation measures and secondary characteristics will be reviewed.

5. Hurricane mitigation measures and secondary characteristics used by the hurricane model, whether or not referenced in Form V-2, Hurricane Mitigation Measures Range of Changes in Damage and Form V-3, Hurricane Mitigation Measures, Mean Damage Ratios and Hurricane Loss Costs (Trade Secret Item) will be reviewed for theoretical soundness and reasonability.

**Form V-1: One Hypothetical Event**

Purpose: This form illustrates the general behavior and reasonableness of building hurricane vulnerability functions for hypothetical windspeeds over hypothetical exposure data.

A. Windspeeds for 96 ZIP Codes and sample personal and commercial residential exposure data are provided in the file named *“FormV1Input17.xlsx.”* The windspeeds and ZIP Codes represent a hypothetical hurricane track. Model the sample personal and commercial residential exposure data provided in the file against these windspeeds at the specified ZIP Codes and provide the damage ratios summarized by windspeed (mph) and construction type.

The windspeeds provided are one-minute sustained 10-meter windspeeds. The sample personal and commercial residential exposure data provided consists of four structures (one of each construction type – wood frame, masonry, manufactured home, and concrete) individually placed at the population centroid of each of the ZIP Codes provided. Each ZIP Code is subjected to a specific windspeed.

For completing Part A, Estimated Damage for each individual windspeed range is the sum of ground up hurricane loss to all structures in the ZIP Codes subjected to that individual windspeed range, excluding demand surge and storm surge. Subject Exposure is all exposures in the ZIP Codes subjected to that individual windspeed range.

For completing Part B, Estimated Damage is the sum of the ground up hurricane loss to all structures of a specific type (wood frame, masonry, manufactured home, or concrete) in all of the windspeed ranges, excluding demand surge and storm surge. Subject Exposure is all exposures of that specific type in all of the ZIP Codes.

One reference structure for each of the construction types shall be placed at the population centroid of the ZIP Codes. Do not include contents, appurtenant structure, or time element coverages.

|  |  |
| --- | --- |
| **Reference Frame Structure:**One storyUnbraced gable end roofASTM D3161 Class D or ASTM D7158 Class D shingles  ½” plywood deck6d nails, deck to roof membersToe nail truss to wall anchorWood framed exterior walls5/8” diameter anchors at 48” centers for wall/floor/foundation connections No shuttersStandard glass windowsNo door coversNo skylight coversConstructed in 1995 | **Reference Masonry Structure:**One storyUnbraced gable end roofASTM D3161 Class D or ASTM D7158 Class D shingles ½” plywood deck6d nails, deck to roof membersWeak truss to wall connectionMasonry exterior wallsNo vertical wall reinforcingNo shuttersStandard glass windowsNo door coversNo skylight coversConstructed in 1995 |
| **Reference Manufactured Home Structure:**Tie downsSingle unitManufactured in 1980 | **Reference Concrete Structure:**Twenty story Eight apartment units per story No shutters Standard glass windows Constructed in 1980 |

B. Confirm that the structures used in completing the form are identical to those in the above table for the reference structures. If additional assumptions are necessary to complete this form (for example, regarding structural characteristics, duration, or surface roughness), provide the reasons why the assumptions were necessary as well as a detailed description of how they were included.

C. Provide a plot of the estimated damage/subject exposure (*y*-axis) versus windspeed (*x*-axis) Part A data.

D. Include Form V-1, One Hypothetical Event, in a submission appendix.

**Form V-1: One Hypothetical Event**

**Part A**

|  |  |  |
| --- | --- | --- |
| Windspeed (mph, One-minute sustained 10-meter) |  | **Estimated Damage/****Subject Exposure** |
| 41 – 50  |  |  |
| 51 – 60  |  |  |
| 61 – 70 |  |  |
| 71 – 80 |  |  |
| 81 – 90 |  |  |
| 91 – 100 |  |  |
| 101 – 110 |  |  |
| 111 – 120 |  |  |
| 121 – 130 |  |  |
| 131 – 140 |  |  |
| 141 – 150 |  |  |
| 151 – 160 |  |  |
| 161 – 170 |  |  |

**Part B**

|  |  |  |
| --- | --- | --- |
| Construction Type |  | **Estimated Damage/****Subject Exposure** |
|  Wood Frame |  |  |
|  Masonry |  |  |
|  Manufactured Home |  |  |
|  Concrete |  |  |

**Form V-2: Hurricane Mitigation Measures and Secondary**

**Characteristics, Range of Changes in Damage**

Purpose: This form illustrates the measure of impact of hurricane mitigation measures and secondary characteristics when implemented individually or in combination at certain windspeeds.

A. Provide the change in the zero deductible personal residential reference building damage ratio (not hurricane loss cost) for each individual hurricane mitigation measure and secondary characteristic listed in Form V-2, Hurricane Mitigation Measures and Secondary Characteristics, Range of Changes in Damage, as well as for the combination of the four hurricane mitigation measures and secondary characteristics provided for the Mitigated Frame Building and the Mitigated Masonry Building below.

B. If additional assumptions are necessary to complete this form (for example, regarding duration or surface roughness), provide the rationale for the assumptions as well as a detailed description of how they are included.

C. Provide this form in Excel format without truncation. The file name shall include the abbreviated name of the modeling organization, the hurricane standards year, and the form name. Also include Form V-2, Hurricane Mitigation Measures and Secondary Characteristics, Range of Changes in Damage, in a submission appendix.

|  |  |
| --- | --- |
| **Reference Frame Building** | **Reference Masonry Building** |
| One storyUnbraced gable end roofASTM D3161 Class D or ASTM D7158 Class D shingles½” plywood deck6d nails deck to roof membersToe nail truss to wall anchorWood framed exterior walls5/8” diameter anchors at 48” centers for wall/floor/foundation connectionsNo shuttersStandard glass windowsNo door coversNo skylight coversConstructed in 1995 | One storyUnbraced gable end roofASTM D3161 Class D or ASTM D7158 Class D shingles½” plywood deck6d nails deck to roof membersWeak truss to wall connectionMasonry exterior wallsNo vertical wall reinforcingNo shuttersStandard glass windowsNo door coversNo skylight coversConstructed in 1995 |
| **Mitigated Frame Building** | **Mitigated Masonry Building** |
| ASTM D7158 Class H shingles8d nails deck to roof membersTruss straps at roofStructural wood panel shutters | ASTM D7158 Class H shingles8d nails deck to roof membersTruss straps at roofStructural wood panel shutters |

Place the reference building at the population centroid for ZIP Code 33921.

**Form V-2: Hurricane Mitigation Measures and Secondary**

**Characteristics, Range of Changes in Damage**

|  |  |
| --- | --- |
| **INDIVIDUAL HURRICANE MITIGATION MEASURES AND SECONDARY CHARACTERISTICS** | **PERCENTAGE CHANGES IN DAMAGE**  **((REFERENCE DAMAGE RATIO - MITIGATED DAMAGE RATIO) / REFERENCE DAMAGE RATIO) \* 100** |
| **FRAME BUILDING** | **MASONRY BUILDING** |
| **WINDSPEED (MPH)\*** | **WINDSPEED (MPH)\*** |
| **60**  | **85**  | **110** | **135**  |  **160** | **60**  | **85** | **110**  | **135** | **160** |
|  | REFERENCE BUILDING | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ |
| ROOF CONFIGUR-ATION | BRACED GABLE ENDS |  |  |  |  |  |  |  |  |  |  |
| HIP ROOF |  |  |  |  |  |  |  |  |  |  |
| ROOF COVERING | METAL |  |  |  |  |  |  |  |  |  |  |
| ASTM D7158 CLASS H SHINGLES  |  |  |  |  |  |  |  |  |  |  |
| MEMBRANE |  |  |  |  |  |  |  |  |  |  |
| NAILING OF DECK | 8d |  |  |  |  |  |  |  |  |  |  |
| ROOF-WALL STRENGTH | CLIPS |  |  |  |  |  |  |  |  |  |  |
| STRAPS |  |  |  |  |  |  |  |  |  |  |
| WALL-FLOOR STRENGTH | TIES OR CLIPS |  |  |  |  |  |  |  |  |  |  |
| STRAPS |  |  |  |  |  |  |  |  |  |  |
| WALL-FOUNDATIONSTRENGTH | LARGER ANCHORS OR CLOSER SPACING |  |  |  |  |  | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ |
| STRAPS |  |  |  |  |  | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ |
| VERTICAL REINFORCING | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ |  |  |  |  |  |
| OPENINGPROTECTION | WINDOWSHUTTERS | STRUCTURAL WOOD PANEL  |  |  |  |  |  |  |  |  |  |  |
| METAL |  |  |  |  |  |  |  |  |  |  |
| DOOR AND SKYLIGHT COVERS |  |  |  |  |  |  |  |  |  |  |
| WINDOW, DOOR, SKYLIGHT STRENGTH | WINDOWS | IMPACT RATED |  |  |  |  |  |  |  |  |  |  |
| ENTRY DOORS  | MEETS WIND-BORNE DEBRIS REQUIREMENTS |  |  |  |  |  |  |  |  |  |  |
| GARAGE DOORS | MEETS WIND-BORNE DEBRIS REQUIREMENTS |  |  |  |  |  |  |  |  |  |  |
| SLIDING GLASS DOORS | MEETS WIND-BORNE DEBRIS REQUIREMENTS |  |  |  |  |  |  |  |  |  |  |
| SKYLIGHT | IMPACT RATED |  |  |  |  |  |  |  |  |  |  |
| **HURRICANE MITIGATION MEASURES AND SECONDARY CHARACTERISTICS IN COMBINATION** | **PERCENTAGE CHANGES IN DAMAGE**  **((REFERENCE DAMAGE RATIO - MITIGATED DAMAGE RATIO) / REFERENCE DAMAGE RATIO) \* 100** |
| **FRAME BUILDING** | **MASONRY BUILDING** |
| **WINDSPEED (MPH)\*** | **WINDSPEED (MPH)\*** |
| **60** | **85** | **110** | **135** | **160** | **60** | **85** | **110** | **135** | **160** |
| MITIGATED BUILDING |  |  |  |  |  |  |  |  |  |  |

*\*Windspeeds are one-minute sustained 10-meter.*

**Form V-3: Hurricane Mitigation Measures and Secondary Characteristics, Mean Damage Ratios and Hurricane Loss Costs**

**(Trade Secret Item)**

Purpose: This form illustrates the measure of impact of hurricane mitigation measures and secondary characteristics when implemented individually or in combination at certain windspeeds. This form also illustrates the underlying hurricane vulnerability functions and the hurricane loss costs for the reference and mitigated constructions.

A. Provide the mean damage ratio (without including any insurance considerations) to the reference building for each individual hurricane mitigation measure and secondary characteristic listed in Form V-3, Hurricane Mitigation Measures and Secondary Characteristics, Mean Damage Ratios and Hurricane Loss Costs (Trade Secret item), as well as the percent damage for the combination of the four hurricane mitigation measures and secondary characteristics provided for the Mitigated Frame Building and the Mitigated Masonry Building below.

B. Provide the zero deductible personal residential hurricane loss cost rounded to three decimal places in the printed form, for the reference building and for each individual hurricane mitigation measure and secondary characteristic listed in Form V-3, Hurricane Mitigation Measures and Secondary Characteristics, Mean Damage Ratios and Hurricane Loss Costs (Trade Secret item), as well as the hurricane loss cost for the combination of the four hurricane mitigation measures and secondary characteristics provided for the Mitigated Frame Building and the Mitigated Masonry Building below.

C. If additional assumptions are necessary to complete this form (for example, regarding duration or surface roughness), provide the rationale for the assumptions as well as a detailed description of how they are included.

D. Provide a graphical representation of the hurricane vulnerability curves for the reference and the fully mitigated building.

|  |  |
| --- | --- |
| **Reference Frame Building** | **Reference Masonry Building** |
| One storyUnbraced gable end roofASTM D3161 Class D orASTM D7158 Class D shingles½” plywood deck6d nails deck to roof membersToe nail truss to wall anchorWood framed exterior walls5/8” diameter anchors at 48” centers for wall/floor/foundation connections No shuttersStandard glass windowsNo door coversNo skylight coversConstructed in 1995 | One storyUnbraced gable end roofASTM D3161 Class D or ASTM D7158 Class D shingles½” plywood deck6d nails deck to roof membersWeak truss to wall connectionMasonry exterior wallsNo vertical wall reinforcingNo shuttersStandard glass windowsNo door coversNo skylight coversConstructed in 1995 |
| **Mitigated Frame Building** | **Mitigated Masonry Building** |
| ASTM D7158 Class H shingles 8d nails deck to roof membersTruss straps at roofStructural wood panel shutters | ASTM D7158 Class H shingles 8d nails deck to roof membersTruss straps at roofStructural wood panel shutters |

Place the reference building at the population centroid for ZIP Code 33921.

**Form V-3: Hurricane Mitigation Measures and Secondary Characteristics, Mean Damage Ratios and Hurricane Loss Costs**

**(Trade Secret Item)**

|  |  |  |
| --- | --- | --- |
| **INDIVIDUAL HURRICANE MITIGATION MEASURES AND SECONDARY CHARACTERISTICS** | **MEAN DAMAGE RATIO** | **HURRICANE** **LOSS COSTS** |
| **FRAME BUILDING** | **MASONRY BUILDING** | **FRAME BUILDING** | **MASONRY BUILDING** |
| **WINDSPEED (MPH)\*** | **WINDSPEED (MPH)\*** | **ACROSS ALL****WINDSPEEDS\*** |
| **60**  | **85**  | **110** | **135**  | **160** | **60**  | **85** | **110**  | **135** | **160** |
|  | REFERENCE BUILDING |  |  |  |  |  |  |  |  |  |  |  |  |
| ROOF CONFIGUR-ATION | BRACED GABLE ENDS |  |  |  |  |  |  |  |  |  |  |  |  |
| HIP ROOF |  |  |  |  |  |  |  |  |  |  |  |  |
| ROOF COVERING | METAL |  |  |  |  |  |  |  |  |  |  |  |  |
| ASTM D7158 CLASS H SHINGLES  |  |  |  |  |  |  |  |  |  |  |  |  |
| MEMBRANE |  |  |  |  |  |  |  |  |  |  |  |  |
| NAILING OF DECK | 8d |  |  |  |  |  |  |  |  |  |  |  |  |
| ROOF-WALL STRENGTH | CLIPS |  |  |  |  |  |  |  |  |  |  |  |  |
| STRAPS |  |  |  |  |  |  |  |  |  |  |  |  |
| WALL-FLOOR STRENGTH | TIES OR CLIPS |  |  |  |  |  |  |  |  |  |  |  |  |
| STRAPS |  |  |  |  |  |  |  |  |  |  |  |  |
| WALL-FOUNDATIONSTRENGTH | LARGER ANCHORS OR CLOSER SPACING |  |  |  |  |  | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ |  | ⎯ |
| STRAPS |  |  |  |  |  | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ |  | ⎯ |
| VERTICAL REINFORCING | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ |  |  |  |  |  | ⎯ |  |
| OPENINGPROTECTION | WINDOWSHUTTERS | STRUCTURAL WOOD PANEL |  |  |  |  |  |  |  |  |  |  |  |  |
| METAL |  |  |  |  |  |  |  |  |  |  |  |  |
| DOOR AND SKYLIGHT COVERS |  |  |  |  |  |  |  |  |  |  |  |  |
| WINDOW, DOOR, SKYLIGHT STRENGTH | WINDOWS | IMPACT RATED |  |  |  |  |  |  |  |  |  |  |  |  |
| ENTRY DOORS | MEETS WIND-BORNE DEBRIS REQUIREMENTS |  |  |  |  |  |  |  |  |  |  |  |  |
| GARAGE DOORS | MEETS WIND-BORNE DEBRIS REQUIREMENTS |  |  |  |  |  |  |  |  |  |  |  |  |
| SLIDING GLASS DOORS | MEETS WIND-BORNE DEBRIS REQUIREMENTS |  |  |  |  |  |  |  |  |  |  |  |  |
| SKYLIGHT | IMPACT RATED |  |  |  |  |  |  |  |  |  |  |  |  |
| **HURRICANE MITIGATION MEASURES AND SECONDARY CHARACTERISTICS IN COMBINATION** | **MEAN DAMAGE RATIO** | **HURRICANE** **LOSS COSTS** |
| **FRAME BUILDING** | **MASONRY BUILDING** | **FRAME BUILDING** | **MASONRY BUILDING** |
| **WINDSPEED (MPH)\*** | **WINDSPEED (MPH)\*** | **ACROSS ALL** |
| **60** | **85** | **110** | **135** | **160** | **60** | **85** | **110** | **135** | **160** | **WINDSPEEDS\*** |
| MITIGATED BUILDING |  |  |  |  |  |  |  |  |  |  |  |  |

*\*Windspeeds are one-minute sustained 10-meter.*

**Form V-4: Percentage Change in Hurricane Mitigation Measures**

**and Secondary Characteristics**

Purpose: This form illustrates the impact of changes in the hurricane model on the hurricane mitigation measures and secondary characteristics from the previously-accepted hurricane model.

A. Provide the percentage change in the individual and combined hurricane mitigation measures and secondary characteristics data compiled in Form V-2, Hurricane Mitigation Measures and Secondary Characteristics, Range of Changes in Damage, relative to the equivalent data compiled from the previously-accepted hurricane model.

B. Provide a list and describe any assumptions made to complete this form.

C. Provide a summary description of the percentage changes.

D. Provide this form in Excel format. The file name shall include the abbreviated name of the modeling organization, the hurricane standards year, and the form name. Also include Form V-4, Percentage Change in Hurricane Mitigation Measures and Secondary Characteristics, in a submission appendix.

**Form V-4: Percentage Change in Hurricane Mitigation Measures**

**and Secondary Characteristics**

|  |  |
| --- | --- |
| **INDIVIDUAL HURRICANE MITIGATION MEASURES AND SECONDARY CHARACTERISTICS** | **PERCENTAGE CHANGE FROM FORM V-2** **RELATIVE TO PREVIOUSLY-ACCEPTED HURRICANE MODEL** |
| **FRAME BUILDING** | **MASONRY BUILDING** |
| **WINDSPEED (MPH)\*** | **WINDSPEED (MPH)\*** |
| **60**  | **85**  | **110** | **135**  |  **160** | **60**  | **85** | **110**  | **135** | **160** |
|  | REFERENCE BUILDING | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ |
| ROOF CONFIGUR-ATION | BRACED GABLE ENDS |  |  |  |  |  |  |  |  |  |  |
| HIP ROOF |  |  |  |  |  |  |  |  |  |  |
| ROOF COVERING | METAL |  |  |  |  |  |  |  |  |  |  |
| ASTM D7158 CLASS H SHINGLES  |  |  |  |  |  |  |  |  |  |  |
| MEMBRANE |  |  |  |  |  |  |  |  |  |  |
| NAILING OF DECK | 8d |  |  |  |  |  |  |  |  |  |  |
| ROOF-WALL STRENGTH | CLIPS |  |  |  |  |  |  |  |  |  |  |
| STRAPS |  |  |  |  |  |  |  |  |  |  |
| WALL-FLOOR STRENGTH | TIES OR CLIPS |  |  |  |  |  |  |  |  |  |  |
| STRAPS |  |  |  |  |  |  |  |  |  |  |
| WALL-FOUNDATIONSTRENGTH | LARGER ANCHORS OR CLOSER SPACING |  |  |  |  |  | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ |
| STRAPS |  |  |  |  |  | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ |
| VERTICAL REINFORCING | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ |  |  |  |  |  |
| OPENINGPROTECTION | WINDOWSHUTTERS | STRUCTURAL WOOD PANEL  |  |  |  |  |  |  |  |  |  |  |
| METAL |  |  |  |  |  |  |  |  |  |  |
| DOOR AND SKYLIGHT COVERS |  |  |  |  |  |  |  |  |  |  |
| WINDOW, DOOR, SKYLIGHT STRENGTH | WINDOWS | IMPACT RATED |  |  |  |  |  |  |  |  |  |  |
| ENTRY DOORS  | MEETS WIND-BORNE DEBRIS REQUIREMENTS |  |  |  |  |  |  |  |  |  |  |
| GARAGE DOORS | MEETS WIND-BORNE DEBRIS REQUIREMENTS |  |  |  |  |  |  |  |  |  |  |
| SLIDING GLASS DOORS | MEETS WIND-BORNE DEBRIS REQUIREMENTS |  |  |  |  |  |  |  |  |  |  |
| SKYLIGHT | IMPACT RATED |  |  |  |  |  |  |  |  |  |  |
| **HURRICANE MITIGATION MEASURES AND SECONDARY CHARACTERISTICS IN COMBINATION** | **PERCENTAGE CHANGE FROM FORM V-2****RELATIVE TO PREVIOUSLY-ACCEPTED HURRICANE MODEL** |
| **FRAME BUILDING** | **MASONRY BUILDING** |
| **WINDSPEED (MPH)\*** | **WINDSPEED (MPH)\*** |
| **60** | **85** | **110** | **135** | **160** | **60** | **85** | **110** | **135** | **160** |
| MITIGATED BUILDING |  |  |  |  |  |  |  |  |  |  |

*\*Windspeeds are one-minute sustained 10-meter.*

**Form V-5: Percentage Change in Hurricane Mitigation Measures and Secondary Characteristics, Mean Damage Ratios and**

**Hurricane Loss Costs**

Purpose: This form illustrates the impact of changes in the hurricane model on the hurricane mitigation measures and secondary characteristics and the underlying hurricane loss costs for the reference and mitigated constructions from the previously-accepted hurricane model.

1. Provide the percentage change in the individual and combined hurricane mitigation measures and secondary characteristics and the zero deductible personal residential hurricane loss costs data compiled in Form V-3, Hurricane Mitigation Measures and Secondary Characteristics, Mean Damage Ratios and Hurricane Loss Costs (Trade Secret item), relative to the equivalent data compiled from the previously-accepted hurricane model.
2. Provide a list and describe any assumptions made to complete this form.
3. Provide a summary description of the percentage changes.
4. Provide this form in Excel format. The file name shall include the abbreviated name of the modeling organization, the hurricane standards year, and the form name. Also include Form V-5, Percentage Change in Hurricane Mitigation Measures and Secondary Characteristics, Mean Damage Ratios and Hurricane Loss Costs, in a submission appendix.

**Form V-5: Percentage Change in Hurricane Mitigation Measures**

**and Secondary Characteristics, Mean Damage Ratios and**

**Hurricane Loss Costs**

|  |  |
| --- | --- |
| **INDIVIDUAL HURRICANE MITIGATION MEASURES AND SECONDARY CHARACTERISTICS** | **PERCENTAGE CHANGE FROM FORM V-3** **RELATIVE TO PREVIOUSLY-ACCEPTED HURRICANE MODEL** |
| **MEAN DAMAGE RATIO** | **HURRICANE** **LOSS COSTS** |
| **FRAME BUILDING** | **MASONRY BUILDING** | **FRAME BUILDING** | **MASONRY BUILDING** |
| **WINDSPEED (MPH)\*** | **WINDSPEED (MPH)\*** | **ACROSS ALL****WINDSPEEDS\*** |
| **60**  | **85**  | **110** | **135**  | **160** | **60**  | **85** | **110**  | **135** | **160** |
|  | REFERENCE BUILDING |  |  |  |  |  |  |  |  |  |  |  |  |
| ROOF CONFIGUR-ATION | BRACED GABLE ENDS |  |  |  |  |  |  |  |  |  |  |  |  |
| HIP ROOF |  |  |  |  |  |  |  |  |  |  |  |  |
| ROOF COVERING | METAL |  |  |  |  |  |  |  |  |  |  |  |  |
| ASTM D7158 CLASS H SHINGLES  |  |  |  |  |  |  |  |  |  |  |  |  |
| MEMBRANE |  |  |  |  |  |  |  |  |  |  |  |  |
| NAILING OF DECK | 8d |  |  |  |  |  |  |  |  |  |  |  |  |
| ROOF-WALL STRENGTH | CLIPS |  |  |  |  |  |  |  |  |  |  |  |  |
| STRAPS |  |  |  |  |  |  |  |  |  |  |  |  |
| WALL-FLOOR STRENGTH | TIES OR CLIPS |  |  |  |  |  |  |  |  |  |  |  |  |
| STRAPS |  |  |  |  |  |  |  |  |  |  |  |  |
| WALL-FOUNDATIONSTRENGTH | LARGER ANCHORS OR CLOSER SPACING |  |  |  |  |  | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ |  | ⎯ |
| STRAPS |  |  |  |  |  | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ |  | ⎯ |
| VERTICAL REINFORCING | ⎯ | ⎯ | ⎯ | ⎯ | ⎯ |  |  |  |  |  | ⎯ |  |
| OPENINGPROTECTION | WINDOWSHUTTERS | STRUCTURAL WOOD PANEL |  |  |  |  |  |  |  |  |  |  |  |  |
| METAL |  |  |  |  |  |  |  |  |  |  |  |  |
| DOOR AND SKYLIGHT COVERS |  |  |  |  |  |  |  |  |  |  |  |  |
| WINDOW, DOOR, SKYLIGHT STRENGTH | WINDOWS | IMPACT RATED |  |  |  |  |  |  |  |  |  |  |  |  |
| ENTRY DOORS | MEETS WIND-BORNE DEBRIS REQUIREMENTS |  |  |  |  |  |  |  |  |  |  |  |  |
| GARAGE DOORS | MEETS WIND-BORNE DEBRIS REQUIREMENTS |  |  |  |  |  |  |  |  |  |  |  |  |
| SLIDING GLASS DOORS | MEETS WIND-BORNE DEBRIS REQUIREMENTS |  |  |  |  |  |  |  |  |  |  |  |  |
| SKYLIGHT | IMPACT RATED |  |  |  |  |  |  |  |  |  |  |  |  |
| **HURRICANE MITIGATION MEASURES AND SECONDARY CHARACTERISTICS IN COMBINATION** | **PERCENTAGE CHANGE FROM FORM V-3** **RELATIVE TO PREVIOUSLY-ACCEPTED HURRICANE MODEL** |
| **MEAN DAMAGE RATIO** | **HURRICANE** **LOSS COSTS** |
| **FRAME BUILDING** | **MASONRY BUILDING** | **FRAME BUILDING** | **MASONRY BUILDING** |
| **WINDSPEED (MPH)\*** | **WINDSPEED (MPH)\*** | **ACROSS ALL** |
| **60** | **85** | **110** | **135** | **160** | **60** | **85** | **110** | **135** | **160** | **WINDSPEEDS\*** |
| MITIGATED BUILDING |  |  |  |  |  |  |  |  |  |  |  |  |

*\*Windspeeds are one-minute sustained 10-meter.*