# Professional Team Report to the Florida Commission on Hurricane Loss Projection Methodology on Inquiries from the Hurricane Standards Report of Activities as of November 1, 2023

## August 21, 2025

Two inquiry topics were assigned to the Professional Team to investigate during the on-site reviews. These inquiries were conducted through conversations with the modeling organizations nearing the conclusion of the on-site review, after the standards had been verified by the Professional Team and reported to the Modeler during the exit briefing. The two inquiries as stated on page 316 in the *Hurricane Standards Report of Activities as of November 1, 2023*, are, as follows:

***Inquiry 1: Roof Covering Type and Attachment***

> The Professional Team is requested to explore with each modeling organization what types of metal, tile, and membrane roof coverings are considered in the model, what variations in attachments are considered in the model, and how building vulnerability functions are developed for the different roof covering types and attachments.

***Inquiry 2: Building and Roof Vulnerability***

> The Professional Team is requested to explore with each modeling organization if and how roof covering loss costs can be separated from total building loss costs, and how policy terms related to roof deductible and actual cash value applied to the roof covering are accounted for in the loss costs produced by the model.

## Inquiry 1 Findings

Before describing facts gleaned from the on-site review inquiries, it is worth noting that most of the material on these topics is already required in the November 1, 2023 Report of Activities. In particular, Standard V-4, Hurricane Mitigation Measures and Secondary Characteristics, states:

A. *Modeling of hurricane mitigation measures to improve a building's hurricane wind resistance, the corresponding effects on hurricane vulnerability, and 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 include:*
   - *Roof strength*
   - *Roof covering performance*
   - *Roof-to-wall strength*
   - *Wall-to-floor-to-foundation strength*
   - *Opening protection*
   - *Window, door, and skylight strength.*

Disclosure 8 under Standard V-4 states:

8. Describe how roof age and roof covering type are incorporated in the hurricane model.

Audit item 8 under Standard V-4 states:

8. For each roof covering type used to complete Form V-2, the following will be reviewed:
   a. Roof age definition as considered in the model, including assumptions,
   b. The association between roof age and year built, including assumptions,
   c. Variation in roof age assumptions (e.g., by region or ZIP Code), and
   d. The impact of roof age on loss costs.

Disclosure 8 typically yields a high-level view of modeling of roof age and covering type while Audit item 8 yields potentially proprietary material during the on-site review with the Professional Team and the trade secret session with the Commission. Appendix 1 of this report reproduces the disclosure responses to Standard V-4 Disclosure 8 by each modeling organization.

There are two basic approaches for developing vulnerability (damage) functions to account for roof covering and attachments. One approach considers roof age, covering and attachments as secondary characteristics to adjust baseline damage functions. An alternate engineering approach quantifies the wind load and resistance directly on building components. Roof age is handled either as the age itself or categorized in age bands (e.g., 0-5 years, 5-10 years, >10 years). Some models work with generic categories of roof covering – namely: metal, shingles and membrane (as called for in Forms V-2, V-3, V-4, and V-5). Other models consider much more detailed classifications of roof covering. Likewise, depending on the model, there are a variety of roof-to-wall connections considered. At minimum, models must consider clips and straps. Appendix 2 lists the options available for roof coverings and attachments for each of the seven models under review to the 2023 Hurricane Standards.

Regarding roof age, all modeling organizations recognize that roofs degrade over time. In the absence of the roof age of an exposure, the modeling organizations have various approaches to deal with this lack of relevant information. The simplest approach is to apply the damage functions with the characteristics that are known. In this case, the roof age may be implicitly incorporated in the development of damage functions. Another possibility is to try to infer a roof age for which the starting point is through the year built characteristic. This works for new construction (less than 20 or 25 years). For older construction, a likely circumstance is that a roof has been replaced. Assumptions need to be made to handle this circumstance. Weighted average damage functions can serve the purpose of circumventing missing roof age data. Unanimously, the modeling organizations expressed a strong desire for insurers to collect roof age information on their exposures and to provide claims data that includes roof age.

To summarize, Inquiry 1 is effectively addressed with public domain material available in the model submissions. Given an exposure's characteristics (including handling of those characteristics that are unknown), the modeling organizations have damage functions to account for them.

## Inquiry 2 Findings

Inquiry 2 concerns building and roof vulnerability as reflected in loss costs. Here the feedback from the modeling organizations was consistent. Insurers do not regularly capture specific replacement values or policy terms pertaining to the roof. Historically and currently, roof information is bundled into the building Coverage A of a policy. A significant shift would be required within the insurance industry for roof specific replacement values and deductibles to become commonplace in how insurers track policy information. In short, at the present time roof covering loss costs cannot be separated from total building loss costs. Further, roof deductibles in policies are not present in the current generation of models, but modeling organizations are aware of movement in this direction.

Professional Team members participating in the Modeler interviews:

Jimmy Booth, Ph.D., Meteorologist
Paul Fishwick, Ph.D., Computer/Information Scientist
Mark Johnson, Ph.D., Statistician, Team Leader
Chris Jones, P.E., Coastal Engineer
Steve Kolk, ACAS, Actuary
Stuart Mathewson, FCAS, MAAA, Actuary
Greg McLellan, P.E., Structural Engineer
Kevin Moran, Ph.D., Computer/Information Scientist
Chris Nachtsheim, Ph.D., Statistician
Mark Powell, Ph.D., Meteorologist
Blake Tullis, Ph.D., Hydraulic Engineer
Masoud Zadeh, Ph.D., P.E., Structural Engineer
Colin Zarzycki, Ph.D., Meteorologist

Modeling organizations participating in the interviews:

CoreLogic/Cotality, Inc.
Florida International University
Impact Forecasting
Karen Clark & Company
Moody's Corporation
Verisk

# APPENDIX 1

## Responses to Standard V-4, Disclosure 8:

***"Describe how roof age and roof covering type are incorporated into the hurricane model."***

### Applied Research Associates (ARA) HurLoss Florida Model 12.0.1 – FCHLPM Submission, pages 116-117:

Roof covering type is incorporated into the hurricane modeling through explicit wind load and component resistance modeling of individual roof cover types (e.g., asphalt shingle, tile, metal, and built-up roofing) within the damage model described in Figure 27. Losses due to roof covering damage state are computed using roof covering specific material and labor costs.

Aging of roof coverings is modeled to reflect the degradation of roof covering attachment over time.

### CoreLogic/Cotality Florida Hurricane Model 2025 – FCHLPM Submission, page 129:

Roof covering and roof age are two key components of CoreLogic's hurricane model as both play critical roles in determining the performance of a building during a hurricane event. As shown in Table 8, roof covering and roof age are part of the Secondary Structural Modifiers (SSM) module. Roof covering includes 22 types of roof materials commonly used in residential and commercial buildings. Similarly, roof age is divided into six age bands to reflect the age of the roof. Roof coverings go through continuous degradation due to environmental conditions which leads to regular replacement. Thus, roof age may not necessarily correlate to the age of the building. Having the roof age independent from the building's age plays a significant role toward reflecting the building's performance in the vulnerability model.

### Florida Public Hurricane Loss Model Version 8.3 – FCHLPM Submission, page 290:

Background: Standard V-1 Disclosure 9 describes the process of incorporating the influence of construction practices and building codes within the models developed to represent the existing residential inventory in Florida. Table 30 in that same disclosure provides the distribution of model variants as a function of construction era and region within Florida. These model variants include differing capacities of exterior building components, with roof covering uplift capacity among them. Standard G-1 Disclosure 2, Tables 1 and 2 explicitly delineate the assignment of strength category to roof cover as a function of the model variant.

Disclosure response: Roof age is explicitly accounted for when assigning an appropriate capacity for roof cover. This is summarized in two stages. Stage one: The most recent dates of construction are assigned more wind resistant roof covering products, as building codes have

increased standards for newer construction. Older construction has weaker roof cover capacity due to both aging and lesser quality as-installed products. Stage two: The re-roofing of a residence is presumed to occur every 20 years. Thus a 35 year old house would be presumed to have new roof cover and re-nailed roof decking (FBC requirement). This corresponds to models W01 and M01 in Table 1in Standard G-1 Disclosure 2. Lastly, the more recent FBC issues include enhanced roof decking and roof cover requirements for the HVHZ compared to inland regions of Florida. Therefore, Table 2 in Standard G-1 Disclosure 2 includes a strong and upgraded strong variants of roof cover.

## Impact Forecasting Florida Hurricane (FCHLPM) Version 3.0 – FCHLPM Submission, page 209:

The impact of roof age and roof covering are calculated based on how these affects (improve or degrade) the wind performance of the structure. The strength of the roofing system components reduces over time and the roofs become more vulnerable to wind loads. Thus, newer roofs generally perform better than older roofs. Similarly, for roof covering the material used to cover the roof affects the roof uplift capacity and debris impact resistance. These adjusted damage functions are used in the elements framework to generate the losses for different roof age and roof covering options. Table 11 lists all the roof age and roof covering options supported in Impact Forecasting vulnerability model.

## Karen Clark & Company (KCC) US Hurricane Reference Model Version 5.0 – FCHLPM Submission, page 131:

The effects of roof age are dependent on the roof covering type. Roofs that are the same age can be impacted differently if the roof covering types have a different expected lifetime. For example, shingle roofs generally have shorter lifetimes than metal roofs. Therefore, a 10-year-old shingle roof receives fewer credits due to roof age compared to a 10-year-old metal roof. In addition, roof age and roof covering type are two different hurricane mitigation and secondary characteristics that impact the same building component. They are combined by multiplying the ratios of the modified vulnerabilities to the original vulnerability as discussed in Standard V-4, Disclosure 6.

## Moody's North Atlantic Hurricane Models Version 25.0 (Build 2450) – FCHLPM Submission, page 138:

Roof age and roof covering type are incorporated in the hurricane model through the secondary characteristics. Roof age includes three options that specify different roof age ranges. Roof covering type includes 13 unique options that can be specified at a building level (see Table 16). For both roof age and roof covering type, depending on the option selected, the vulnerability functions can either increase or decrease compared to the default (unknown) case.

## Verisk Hurricane Model for the United States V3.0.0 as Implemented in Touchstone® 2024A – FCHLPM Submission, page 157:

The Verisk Individual Risk Model is integrated in the hurricane loss projection model to estimate the impact of mitigation features and secondary characteristics including roof age (or roof year built) and roof cover on building vulnerability. When any combination of the individual mitigation features and secondary characteristics listed in Table 13 is provided, the individual risk model calculates the corresponding credits and applies them to the base vulnerability functions to obtain refined vulnerability functions for buildings with the specified features. The Verisk Individual Risk Model has been developed using a structured, engineering based framework that applies structural engineering expertise and building damage observations made in the aftermath of actual hurricanes (See Appendix 8: Accounting for Secondary Risk Characteristics for details). The approach was described in great length in Disclosure V-4.5.

# APPENDIX 2
# Roof Coverings and Attachments

## Applied Research Associates (ARA) HurLoss Florida Model 12.0.1 – FCHLPM Submission, page 105.

Roof Age:
- Unknown
- Actual Age

Roof Covering:
- Unknown
- Tile
- Shingle
- Metal

Roof-Wall Connection:
- Unknown
- Toe Nailed
- Clips
- Straps

Roof Sheathing:
- Unknown
- Nailing of deck 6d@6/12
- Nailing of deck 8d@6/12
- Nailing of deck 8d@6/6

## CoreLogic/Cotality Florida Hurricane Model 2025 – FCHLPM Submission, pages 120-123.

Roof Age:
- Unknown
- Less than 6 Years
- 6 to 10 Years
- 11 to 15 Years
- 16 to 20 Years
- More Than 20 Years

Roof Covering:
- Unknown or Other
- Ordinary Asphalt Shingles/Three-tab Composition Shingles
- Asphalt Shingles: Wind Event Rated, Class G
- Built-Up Roofing (Gravel Aggregate Surfaced)
- Asbestos Cement
- Asphalt on Slab, Sprayed Polyurethane Foam (SPF)
- Single-ply Membrane, Not Attached
- Single-ply Membrane, Attached (EPDM, PVC, and TPO)
- Metal Decking
- Wood or Cedar Shingles, Wood or Cedar Shakes
- Slate/Tile

Fire Resistive/Fiber-Cement Tiles
Asphalt Shingles: Wind Event Rated, Class D and Class H
Polymer Modified Asphalt Shingle: APP, SBS (Hail)
Impact Resistant (IR) 3-tab, IR Architectural Shingles
Built-up Roofing: Aluminum Coated
Built-up Roofing: Coal Tar Coated
Concrete Tile Shingles (Flat and S-shaped)
UL 2218 Class-1, FM 4473 Class-1, Class 2, Class 3, and Class 4
Photovoltaic Shingles-No Class
Photovoltaic Shingles-Class D and Class F
Photovoltaic Shingles-TAS 107

Roof-to-Wall Connection:

Unknown or Unable to Locate
No Connection
Partial Connection
Bolted along with Nails (Wood Frames)
Ordinary Box Nails (Wood Frames)
Straps, Clips or Extra Strengthening such as Wraps and Double Wraps
Tie-down Straps in RC (Masonry Walls)
Bolted or Welded Connections
Integrated RC Slab with Masonry Wall

Roof Sheathing:

Unknown
Wood (Except Plywood)
Reinforced Concrete
Gypsum Concrete
Metal Deck without Concrete
Metal Deck with Concrete
Metal Deck with Insulation
Waferboard
Plywood Sheets or OSB with 6d Nailing
Plywood Sheets: Sealed Joints and 6d Nailing
Plywood Sheets with 8d Nailing
Plywood Sheets with 8d Ring Shank Nailing
Plywood Sheets: Sealed Joints and 8d Nailing
Plywood Sheets: Sealed Joints and 8d Ring Shank Nailing
Plywood Sheets: ASTM Felt and 6d Nailing
Plywood Sheets: ASTM Felt and 8d Nailing
Plywood Sheets: ASTM Felt and 8d Ring Shank Nailing
Plywood Sheets: Sealed Joints + ASTM Felt and 6d Nailing
Plywood Sheets: Sealed Joints + ASTM Felt and 8d Nailing
Plywood Sheets: Sealed Joints + ASTM Felt and 8d Ring Shank Nailing
Plywood Sheets or OSB with Unknown Nailing
Plywood Sheets: Sealed Joints with Unknown Nailing
Plywood Sheets: ASTM Felt with Unknown Nailing
Plywood Sheets: Sealed Joints + ASTM Felt with Unknown Nailing
Plywood Sheets: ASTM_Underlayment_FBC2017 and 6d Nailing
Plywood Sheets: ASTM_Underlayment_FBC2017 and 8d Nailing
Plywood Sheets: ASTM_Underlayment_FBC2017 and 8d Ring Shank Nailing

Plywood Sheets: Sealed Joints + ASTM_Underlayment_FBC2017 and 6d Nailing
Plywood Sheets: Sealed Joints + ASTM_Underlayment_FBC2017 and 8d Nailing
Plywood Sheets: Sealed Joints + ASTM_Underlayment_FBC2017 and 8d Ring Shank Nailing

## Florida Public Hurricane Loss Model Version 8.3 – FCHLPM Submission, pages 28, 306.

Roof Age:

Roof Cover Capacity Assignment

- Re-roofing of a Residence Presumed to Occur Every 20 Years

Roof Covering:

Unknown
Shingle
Tile
Metal
Other Florida Building Code Compliant
Other Non-Florida Building Code Compliant

Roof-to-Wall Connection:

Unknown
Toe Nailed
Clips
Straps
Other

Roof Sheathing:

Unknown
Planks
With 6d@6/12
With 8d@6/12
With 8d@6/6
Other (e.g., Reinforced Concrete Deck Attachment)

## Impact Forecasting Florida Hurricane (FCHLPM) Version 3.0 – FCHLPM Submission, pages 198-200.

Roof Age:

Unknown
0 to 5 Years
5 to 10 Years
> 10 Years

Roof Covering:

Unknown
Shingles (90 mph)
Tiles
Rated Shingles (150 mph)
Rated Shingles with Secondary Water Barrier
Metal
Membrane

Roof-to-Wall Connections:
- Unknown
- No Strap and No Toe Nailed
- Toe Nailed
- Straps
- Clips

Roof Sheathing:
- Unknown
- With 6d@6/12
- With 8d@6/12
- With 8d@6/6
- Metal
- Concrete

## Karen Clark & Company (KCC) US Hurricane Reference Model Version 5.0 – FCHLPM Submission, pages 125-126.

Roof Age:
- Continuum

Roof Covering:
- Unknown
- Shingle, Class D, Class F, Class G, and Class H
- Shingle, Hurricane Rated
- Shingle, Not Hurricane Rated
- Shingle, Unknown
- Tile, Clay (Mortar, Adhesive, Mechanical/Nail Attachment)
- Tile, Concrete (Mortar, Adhesive, Mechanical/Nail Attachment)
- Tile, Unknown
- Light Metal Panels
- Standing Seam Metal
- Built Up
- Single Ply Membrane
- Wood Shakes
- Modified Bitumen
- Slate

Roof-to-Wall Connection:
- Unknown
- Anchor Bolts
- Toe Nailed
- Clips/Ties
- Single Wrap
- Double Wrap
- Structural Connection

Roof sheathing
- Unknown
- Plywood 6d@6/12
- Plywood 8d@6/12
- Plywood 8d@6/6
- Plywood Unknown

OSB 6d@6/12
OSB 8d@6/12
OSB 8d@6/6
Wood Planks
Metal
Concrete

## Moody's North Atlantic Hurricane Models Version 25.0 (Build 2450) – FCHLPM Submission, pages 134-135.

Roof Age:
- Unknown
- 0 to 5 years
- 6 to 10 years
- 11 years or more
- Obvious Signs of Duress and Distress

Roof Covering:
- Unknown
- Metal Sheathing with Exposed Fasteners
- Metal Sheathing with Concealed Fasteners
- Built-up or Single-ply Membrane with Presence of Gutters
- Built-up or Single-ply Membrane without Presence of Gutters
- Concrete/Clay Tiles
- Wood Shakes
- Normal Shingle
- Normal Shingle with Secondary Water Resistance
- Shingle Rated for High Windspeeds
- Shingle Rated for High Windspeeds with Secondary Water Resistance
- Concrete
- Bermuda-style
- Fabric (Tensile Membrane)

Roof-to-Wall Connection:
- Unknown
- Toe Nailing/No anchorage
- Clips
- Single Wraps
- Double Wraps
- Structural

Roof Sheathing:
- Unknown
- Batten Decking/Skipped Sheathing
- 6d Any Nail Schedule
- 8d Minimum Nail Schedule
- 8d High Wind Nail Schedule
- 10d High Wind Nail Schedule
- Dimensional Lumber/Tongue & Groove with a Minimum of 2 Nails per Board

**Verisk Hurricane Model for the United States V3.0.0 as Implemented in Touchstone® 2024A – FCHLPM Submission, pages 410-411.**

Roof Age:
- Year the Roof was Put in Place

Roof Covering:
- Unknown/Default
- Asphalt Shingles
- Wood Shingles
- Clay/Concrete Tiles
- Light Metal Panels
- Slate
- Built-up with Gravel
- Built-up without Gravel
- Single-ply Membrane
- Single-ply Membrane Ballasted
- Standing Seam Metal
- Hurricane Wind Rated

Roof-to-Wall Connection:
- Unknown/Default
- Hurricane Ties
- Nails or Screws
- Anchor Bolts
- Gravity or Friction
- Adhesive Epoxy
- Structurally Connected
- Clips

Roof Sheathing:
- Unknown/Default
- Structurally Connected
- Screws/Bolts
- Adhesive/Epoxy
- With 6d@6/12
- With 8d@6/12
- With 8d@6/6
- Metal with Concrete
- Plywood
- Pre-cast Concrete Slabs
- Wood Planks
- Reinforced Concrete Slabs
- Particle Board/OSB
- Light Metal
- Metal with Insulation Board