

## UNDERSTANDING THE EFFECTS OF LONG-TERM WEATHERING: IBHS Roof Aging Farms



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*Many roofing products are known to degrade over time, with the amount of degradation expected to vary with local environmental conditions. Controlled aging of roofs in various climates coupled with systematic testing for wind, fire, and hail will provide needed data to improve vulnerability assessments and understand the rate at which materials degrade and the severity.*

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### Areas of Focus

In 2013, IBHS initiated a long-term aging program to study performance of aged roofing materials when subjected to high wind, fire, or impact tests. The aging program considers material type, roof pitch, and type of weathering across differing ages to investigate product durability. IBHS will use laboratory wind, fire, and hail impact testing results of the aged roofs to develop damage curves.

Over the last decade IBHS has and continues to expand the roof aging farm program by adding roofs with different asphalt shingles products and other common residential roofing materials. With support of IBHS member companies, aging farms were constructed in Madison, Wisconsin and Amelia, Ohio in 2014, in Olathe, Kansas in 2017, and Foley, Alabama in 2018.

### Impact of Climate Zones

Length of time and local climate effects may both play a major role in the aging of certain materials. Located in Richburg, SC, the IBHS Research Center is in a climate characterized by hot and humid summers and generally mild winters, with occasional snow and ice. Researchers are interested in the effects of other climates, particularly:

- Colder
- Warmer
- Wetter
- Drier
- Prolonged snow and ice
- Thermal shocks caused by thunderstorm rain

In the Köppen Climate Classification System, there are 20 subclimates and five primary zones in the contiguous United States including tropical, arid, temperate, cold, and polar. IBHS continues to pursue collaborations with partners to construct aging farms in each of these five main climate zones in order to understand how building materials weather differently based on climate.

## Project Scope

### On Your Campus

The IBHS Roof Farm program was developed to ensure consistent designs and focused variability. In each of the two possible installation styles, each specimen includes multiple panels for wind, fire, and hail impact testing. Each specimen also features north-facing and south-facing panels to examine differences due to incident solar radiation. Specimens are constructed in sets of four to allow for comparisons amongst the aging timeframes. Each collaborator can choose to construct one or three sets, but full sets must be installed, as partial sets would leave out some age categories.



*Figure 1. Collaborators can choose from two styles of specimen installation. On the left, the picnic hut style installation on a post system approximately 8 ft above ground level with a concrete pad underneath which is suitable to place picnic tables underneath. On the right, the traditional hut style installation on a post system approximately 4 ft above ground level.*

Specific characteristics of the farm include:

1. Specimens are nominally 15 ft by 15 ft simple gable roofs with a 6/12 pitch and code-required soffit and ridge ventilation; roofs are enclosed on the sides and bottom to create a ventilated "attic."
2. Specimens are constructed in a grid, with 8 ft wide paths in between for ease of access and to reduce shadows.
3. Roof products are selected based on type, manufacturer, market prevalence, and standard test ratings to give variation. Similar colors were selected.
4. Six removeable test panels—three north-facing and three south-facing—are constructed and installed in the main specimen structure before roof covering is applied.
  - a. These 55 in. by 66 in. panels are designed for use in ASTM 3161, ASTM 7158, ASTM E1354, and IBHS original impact test methods.
  - b. Each specimen set comprises four specimens, one to age for each age category of 5, 10, 15, and 20 years. Six panels of each material are constructed for the baseline testing of the product in its new state.

### Siting Requirements

A single set of specimens covers about 0.07 acres (2,900 sq ft) while three sets cover about 0.2 acres (8,700 sq ft). Open, sunny locations are strongly preferred. Shade from nearby buildings or trees will affect sunlight, temperature, melting of snow and ice, evaporation of rain and dew, and activation of

sealant strips on asphalt products. If an open location is not available, IBHS staff will evaluate the space and determine additional instrumentation that might be required to effectively document roof conditions.

## Instrumentation

To fully understand climate effects on roofing products, several instruments must be placed on/near the specimens and monitored for the duration of the project. These data are necessary for analysis to understand roof conditions and to allow for comparisons with specimens from other farms. An automated downloading instrumentation system will be implemented, with data sent directly to IBHS.

1. The 20-year specimens for each set feature four temperature sensors (Type K thermocouples), placed on the center panel. Relative humidity sensors are placed in the attic space of select specimens.
2. One selected specimen for the site will be equipped with thermocouples in the attic space.

Each farm will be equipped with a weather station to monitor ambient temperature and relative humidity. The station may also include a tipping-bucket rain gauge, pyranometer, and thermocouples. The weather station has no set height but will be fenced in and should be within 30 ft from the set of huts.

A portion of the instrumentation will provide infrastructure common to all sets, making additional sets at the same site less expensive than the first.

## Budget Estimates

	Total Cost
1 set of specimens for 1 roofing product (4 huts)	\$50,000-\$57,000
3 sets of specimens for 4 roofing products (12 huts)	\$129,200-\$142,600

Cost varies by location.

## Support

IBHS will supply all necessary construction drawings to ensure the specimens constructed on collaborators' land are consistent with the original specimens constructed at the IBHS Research Center. A list of construction materials will also be supplied. IBHS staff will be available to provide support to collaborators during the instrumentation construction and installation processes.

Collaborators will be asked to maintain the specimens and notify IBHS of any events/conditions (e.g., power outage, adverse weather event, etc.). IBHS will need access to the site to conduct annual inspections of the specimens or off-scheduled checks if permitted. During these visits IBHS may need help sourcing equipment like ladders. An onsite contact is requested for IBHS personnel during these situations.



*Figure 2. IBHS staff conduct annual visual inspections of each specimen.*