ASPHALT COMPOSITION SHINGLE DAMAGE –

Hail or Manufacturing Defect?

BY DARRELL L. SMITH, RRC, PE

Asphalt composition shingles are the most common residential roofing materials in the United States.

"Asphalt shingles age naturally due to exposure to the elements and become more brittle with time. Shingles that have manufacturing defects or installation deficiencies can deteriorate more rapidly. Damage caused by natural or man-made factors can reduce the water-shedding capability and/or expected service life of a roof. Some common manufacturing issues include localized granule loss, blisters, color variations, splitting, delamination, shingle splices, and spot defects."[1]

The area of the United States that receives the most hail is limited to a relatively small area east of the Rockies and west of the Mississippi River. *Figure 1* is a map from "The Climatology of Hail in North America" by meteorologist Stanley A. Changnon, Jr., published in Monograph No. 38 by the American Meteorological Society (107-128, 1996), showing the number of days of hail for the United States for an average year.[2]

According to annual hail summaries by the National Oceanic and Atmospheric Administration (NOAA), "Property damage reached an all-time high (at the time) of $2.4 billion in 2001. Because of the frequency of hail damage to roof systems, many roofing professionals, insurance professionals, and homeowners mistakenly assume a roof system needs to be replaced or repaired following a hailstorm. However, this is not always the case."[3]

The majority of hailstorm events produce hailstones varying in hardness, shape, and size. Smaller hailstones less than ½ inch are much more common than larger hailstones. Hail falls randomly, with the source direction influenced by wind, and usually leaves observable signs where it has landed.

Asphalt shingles are particularly vulnerable to hail damage in the valleys, shingle tab edges, and shingle overlap areas. These areas should be reviewed following a hailstorm event.

Table 1 shows a tabulation of the smallest threshold sizes of hail that typically can damage common steep-sloped roof cover-

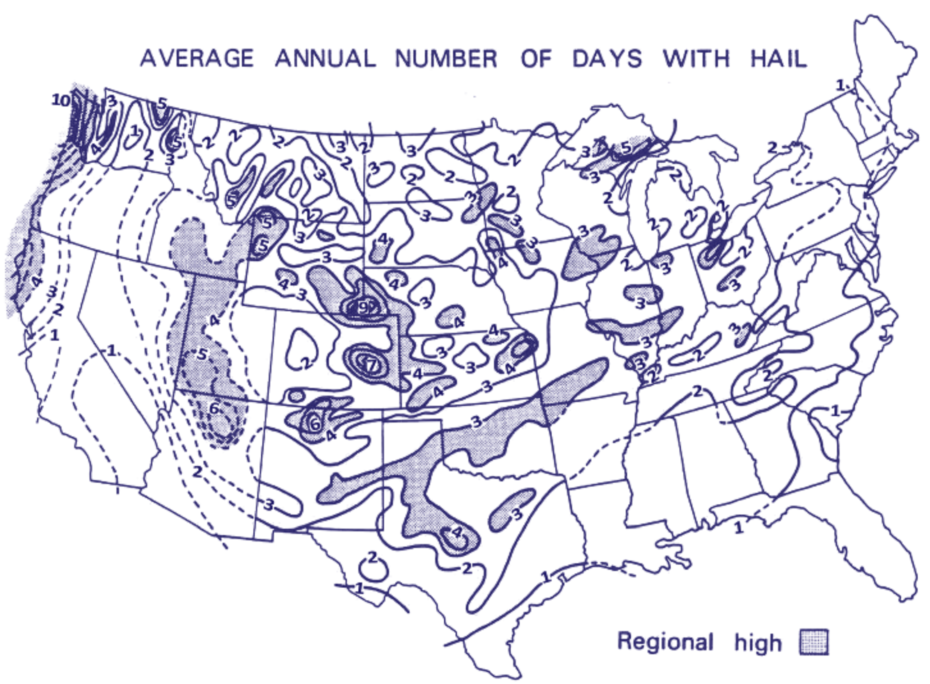

Figure 1 – The average number of days with hail across the United States.

Hail Thresholds for Steep-Sloped Roof Coverings	
Roof Type	**Threshold (inches)**
Asphalt three-tab lightweight composition shingles	1
Asphalt-laminated heavyweight composition shingles	1¼
Wood shingles	1¼
Wood shakes (medium)	½
Gray slates (¼ of an inch thick)	1½
Green slates (¼ of an inch thick)	1¾
Concrete tiles	1¾
Clay tiles	1½

Table 1 – The smallest threshold sizes of hail that can damage various steep-slope roof coverings.

ings.[4] These thresholds are the result of more than 45 years of lab testing with simulated hail and tens of thousands of field inspections by insurance companies and third-party assessors. These thresholds are provided with the following assumptions: dense hail, perpendicular impacts, reasonable support of the roof covering, and roof systems in relatively good shape.

Asphalt or composition shingles, in order to be considered functionally damaged, have to be punctured or fractured by the hailstone. Functional damage to a roof system does not occur unless water shedding or the waterproofing capacity is reduced or the roof's expected service life is reduced.

An observable mark where the granules are missing from the shingle's surface may leave a puncture or fracture in the shingle. A hail impact fracture affects the shingle's underside and the granule surface. A hail-impact fracture is usually observable on a shingle's underside. A fracture on a shingle's underside usually results in a fracture in the shingle reinforcement mat. This damaged reinforcement mat reduces the shingle's water-shedding capabilities and is considered functional damage.[5]

Most fractures are visible on the granule surfacing of the shingle. The shingle surface can be felt with the fingertips for any "soft" spots, called "bruises."

A hailstone that dislodges the granules, exposes the asphalt binder, and fractures the reinforcement mat—generating a detectable bruise—is considered functional damage. Shingles that lose enough granules to expose the asphalt bitumen binder but do not have any fractures in their reinforcement mat are probably nearing the end of their service lives. The granule surface loss is due to natural aging or defective

Photo 1 – East view of commercial building.

Photo 2 – View of ridge cap and shingles.

Photo 3 – View of west slope, south end.

Photo 4 – View of east slope.

Photo 5 – West slope, close-up of cracking of granule surfacing on shingles.

manufacturing. The loss of granules is an ongoing process that begins at the time of a shingle's manufacture and is considered normal aging. Granule loss by itself is not considered functional damage.[6]

Insurance companies typically employ a third party to evaluate cases where the adjustor has noted that the shingle damage is not due to hail. Typically, this third party is a roof consultant, engineer, architect, or other individual with sufficient training and expertise to provide an expert opinion on the cause of the shingle damage.

In 2009, two steep-slope roofs in communities over 35 miles apart "as the crow flies" and 50 miles by highway were reviewed for assessment of the damage apparent on the shingles. The shingles appeared to be from the same manufacturer. The following is a summary of visual investigation performed on the roofs. The first roof noted is on a commercial building, while the second roof is on a residential structure.

VISUAL SUMMARY

Commercial Building

There are several hail events listed in the National Climate Database for this area. The largest hailstone size recorded in the subject community from February 2008 to April 2009 was 1 inch in diameter. The building in *Photo 1* is a one-story structure. The shingles are a laminated shingle with decorative coursing of the granules. For the purpose of this report, the main entry from the street is presumed to face east.

Photos 2 though *4* show a general view of the various roof slopes and ridge caps on the building. No impact marks normally associated with hail were observed. Curling of the shingle edges appeared to be present on some of the shingles. Photos of the west

Photo 6 – West slope, cracking of granule surfacing.

slope (*Photos 5* and *6*) show that cracking of the granule surfacing was prevalent on the majority of the shingles. No fractures on the underside of the shingles were observed where the granule surfacing was cracked. Deterioration at the tab edges also was prevalent.

The shingles on the east slope also showed cracking of the granule surfacing and deterioration at the tab edges. The shingles over the entry roof area were starting to show cracks in the granule surfacing. No fractures on the underside of the shingles were observed where the granule surfacing was cracked.

Residential Building

This investigation was due to a hailstorm event that occurred August 3, 2008, at the subject location. Per the local weather service reports, the closest officially recorded hail event for that day was approximately 5.5 miles distant. The recorded hailstone size for that location was 1.5 inches in diameter. The building is a multistory structure (*Photo 7*) with various roof slopes.

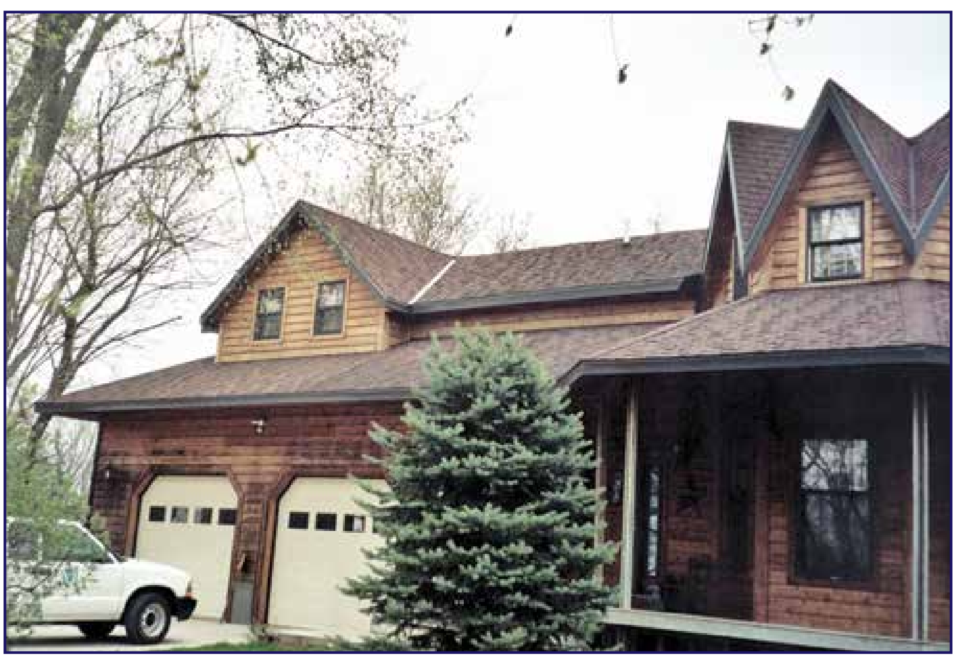

Photo 7 – View of west side (front) and north end of house.

Photo 8 – View of SE valley on upper main roof. No impact marks on metal.

Photo 9 – View of NE valley and shingles on north end of south slope. No impact marks on metal valley.

Photo 10 – View of deteriorated shingles on east lower slope.

Photo 11 – View of deteriorated shingles and metal valley. No impact marks on metal on north end of upper west-side roof.

Photo 12 – Shingles on steep-slope section, south end.

The shingles laminated with decorative coursing of the granules. For the purpose of this report, the main entry and garage doors shown in *Photo 7* are presumed to face west.

Photos 8 through *11* show a general view of the various roof slopes and metal valleys on the building. No impact marks normally associated with hail were observed in the metal valleys.

Curling of the edges appeared to be present on some of the shingles. The metal furnace vent on the east slope of the main house had no sign of hail impact marks present.

Photo 12 is a view of one of the steep slopes at the southwest corner of the house. The shingles on these steep-sloped sections appeared to be in generally good condition. The shingles on the lower and majority of the upper roof slopes con-

Photo 13 – Close-up of cracking granule surfacing on the east slope of the lower roof.

Photo 14 – Close-up of cracking granule surfacing on the north end of the upper roof.

Photo 15 – Close-up of cracking granule surfacing on the west slope of the lower north end.

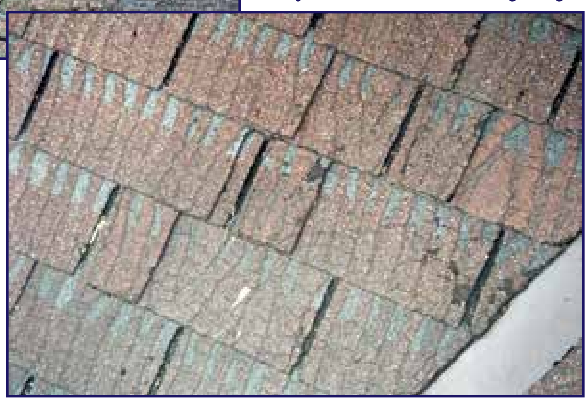

Photo 16 – Close-up of cracking granule surfacing on the south slope of the upper roof north end over the garage.

sistently were in a deteriorated condition (*Photos 13-16*) and had cracking throughout the granule surfacing on the majority of the shingles. No fractures on the underside of the shingles were observed where the granule surfacing was cracked. Deterioration at the tab edges also was prevalent.

CONCLUSIONS AND RECOMMENDATIONS

It was apparent that the shingles were from the same manufacturer. In both instances, recorded hail size for each roof was between 1 to 1.5 inches. On both roofs, no associated hail impact marks were seen on the more vulnerable areas of the valleys, tabs, edges, and overlaps.

The deterioration of the shingles was consistent throughout the majority of the roof slopes that were at a typical roof pitch of 4 to 5 inches per foot. This type of consistent damage on both structures usually points to either a shingle-manufacturing defect, natural deterioration, or other problem rather than hail damage. By using a third-party consultant to assist with the evaluation, each insurance company was able to reduce the total claim amount for each storm event noted.

FOOTNOTES

1. *Composition Roofs Damage Assessment; Field Guide*, Haag Engineering Company, 1st Edition, 2006.
2. "Hail Damage to Shingles," Colin Murphy, RRC; *Interface*, January 1998, RCI, Inc.
3. "Learn How to Identify Hail Damage on Roof Systems," Scott J. Morrison, *Professional Roofing*, May 2009, National Roofing Contractors Association.
4. *Ibid.*
5. *Ibid.*
6. *Ibid.*

Darrell L. Smith, RRC, PE

Darrell L. Smith, RRC, PE, is a principal at VJ Engineering, based in eastern Iowa. He has been providing roof/building envelope consulting services with VJ Engineering since 1991 and is the building envelope/roof engineering/consulting department leader responsible for all roofing and the majority of building envelope projects. Darrell is a member of RCI, Inc.; ASTM Committees D08 on Roofing, Waterproofing, and Bituminous Materials; ASTM Committee E06 on Performance of Buildings; ASTM Committee E58 on Forensic Engineering; Building Enclosure Technology and Environmental Council; Multi Hazard Mitigation Council; the Facility Maintenance and Operations Committee; and the Building Smart Alliance. He is also past state president of the Iowa Engineering Society, and on the Regional Sustainable Business Alliance—a committee of the Cedar Rapids Chamber of Commerce.