Mastering Roof Inspections: Hail Damage, Part 4

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The purpose of the series "Mastering Roof Inspections" is to teach home inspectors, as well as insurance and roofing professionals, how to recognize proper and improper conditions while inspecting steep-slope, residential roofs. This series covers roof framing, roofing materials, the attic, and the conditions that affect the roofing materials and components, including wind and hail.

Density

Studies have shown that hailstones vary in density. The density of a hailstone is an indication of how hard it is. The layers of ice, which accumulate as a hailstone grows, often contain air bubbles which make the hailstone softer, lighter and less likely to cause damage.

A low-density hailstone can have more in common with a snowcone than it does with a hailstone.

Softer hailstones leave distinctive marks called “spatter,” which can be a good indicator of the size, density and quantity of hail fall.

Although softer stones may not damage roof-covering materials, they may leave noticeable, temporary marks on whatever they hit. Instead of indentations, spatter often leaves marks resulting from the removal of surface oxidation, particulates such as dust and dirt, or microbial growth.

Velocity

Another word for the speed at which a hailstone falls out of the sky is its velocity. The velocity at which a hailstone falls is limited by its aerodynamic shape, its size, and the quality of its surface.

The fastest speed at which an object of a specific shape can possibly fall is called its terminal velocity or free-fall speed. The terminal velocity of hailstones is important because the faster a hailstone falls, the more impact-energy it carries. A hailstone falling fast is more likely to cause damage when it hits than a similar hailstone falling more

slowly.

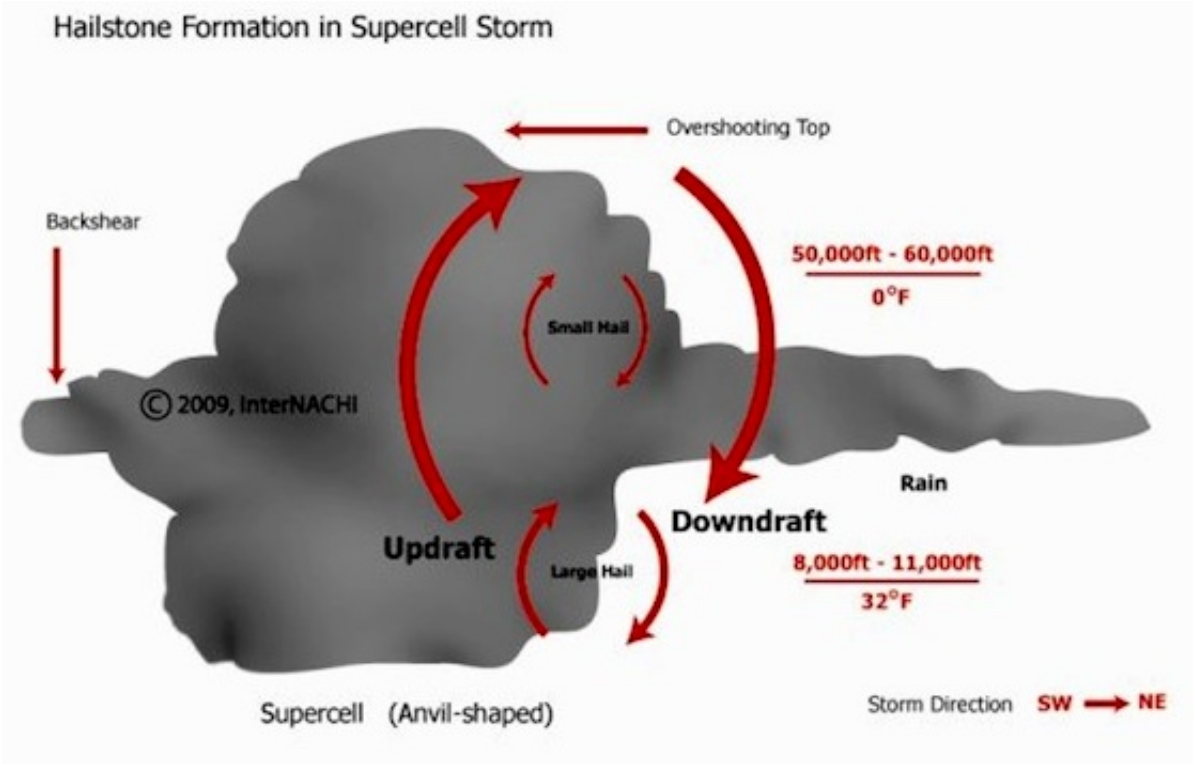
Hail Fall-Speed Table
(Greenfield, 1969)

Hail Diameter		Terminal Velocity		Impact Energy	
in.	**cm**	**mi/hr**	**m/sec**	**ft.-lbs.**	**Joules**
1	2.5	50	22.3	<1	1.36
1¼	3.2	56	25	4	5.42
1½	3.8	61	27.4	8	10.85
1¾	4.5	66	29.6	14	18.96
2	5.1	72	32	22	29.8
2¼	5.8	76	34	34	46.01
2½	6.4	80	35.7	53	71.9
2¾	7	84	37.6	81	109.8
3	7.6	88	39.6	120	162.7

This Hail Fall-Speed Table shows the terminal velocities for hailstones of different sizes, and the impact-energy each size carries. It assumes that hail is smooth and spherical.

If you compare the speed and impact-energy of a 1-inch hailstone to that of a 3-inch hailstone of equal density, it's easy to see why larger hailstones do more damage. The 1-inch hailstone falls at about 50 miles per hour and carries less than 1 foot-pound of impact-energy. The 3-inch hailstone falls at almost 90 miles per hour and carries 120 foot-pounds of impact-energy.
Impact-energy increases exponentially as hailstone size increases.

Variation Within Storms



It's not unusual for hail within a single storm to carry different amounts of impact-energy. Hail at the leading and trailing edges of the storm may have characteristics different from hailstones falling from the main body of the storm, since the conditions at the edges of the storm will be different from those in the middle.

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