2.1 Effects of Weathering

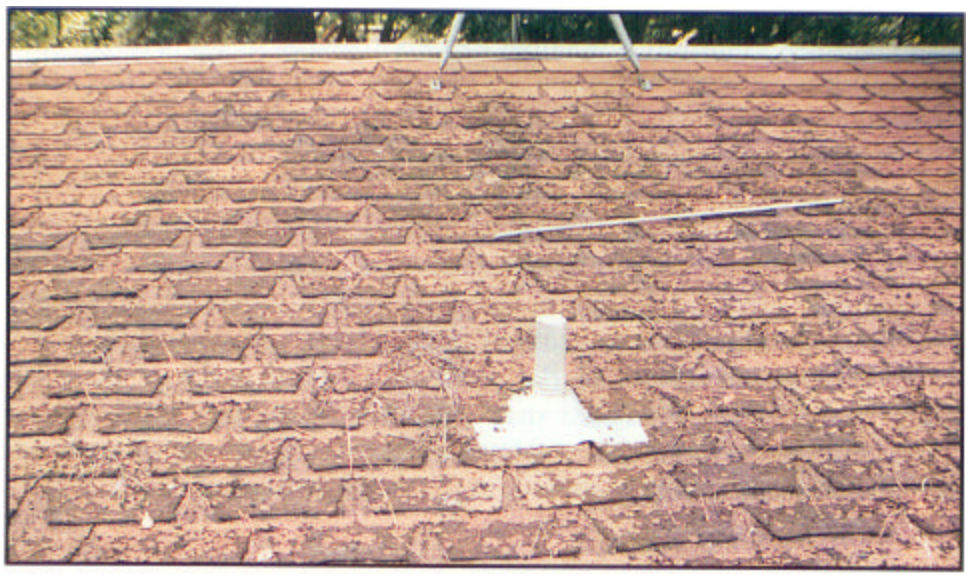

Photo 2.1.1 Weathering occurs when composition shingles are exposed to the elements. The originally rectangular tabs become trapezoidal as the asphalt becomes brittle and shrinks.

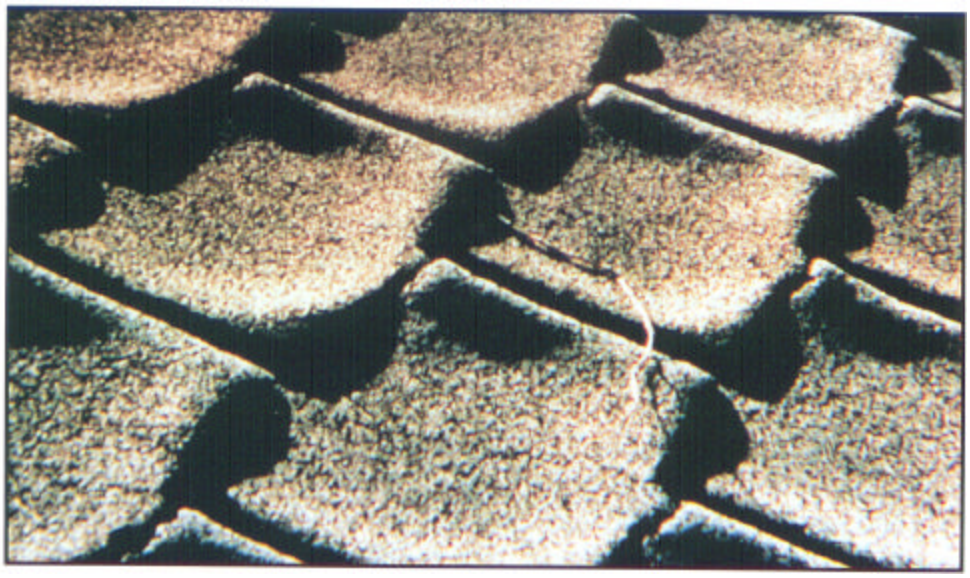

Photo 2.1.2 Composition shingles age as they bake in the sun, leaving behind brittle asphalt. Shingle areas with greatest exposures, tab edges and butts, exhibit the most rapid aging. Depicted are organic shingles displaying characteristic cupping and curling plus downward curling tab edges and butts resulting from water that wicked into and swelled the organic felts.

(Effects of Weathering, Cont'd.)

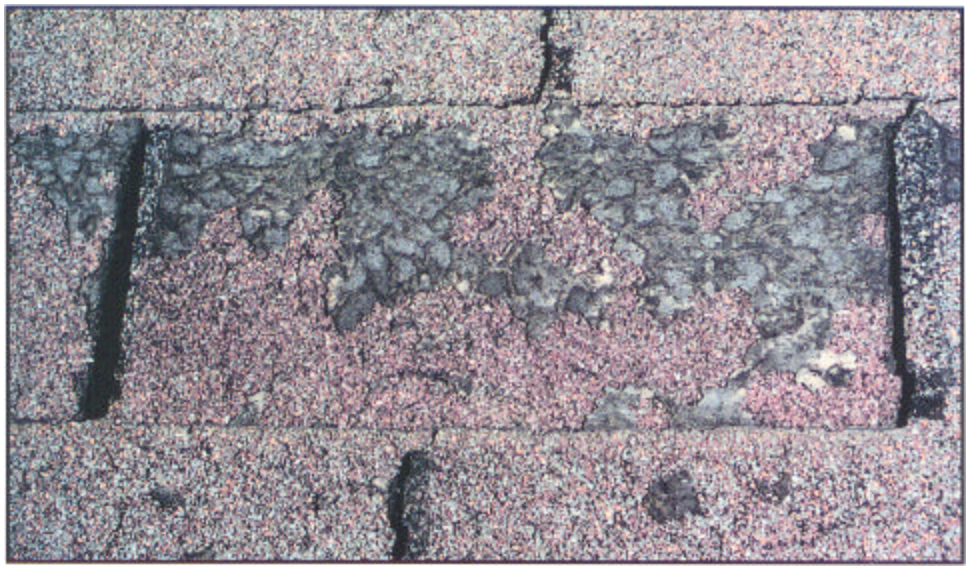

Photo 2.1.3 Close-up of a weathered composition roof. Note absence of granules from shingle tabs as well as tattered butt edges ("scuffed butts"). Very often, shingle butts become scuffed and broken in more trafficked areas along ridges and valleys.

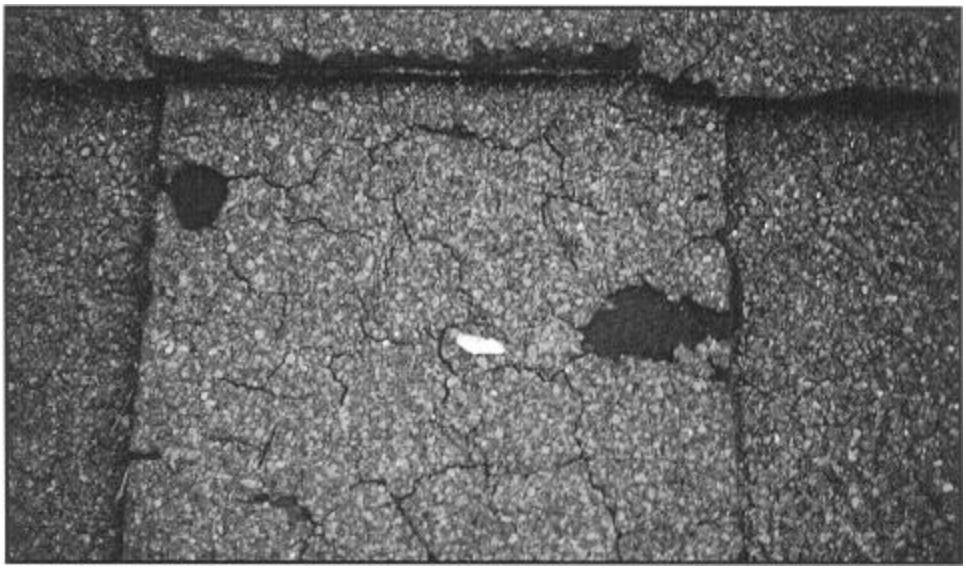

Photo 2.1.4 The web-like pattern of cracks in the surfaces of these shingles is termed "craze cracks," "crazing," or "map cracks." Although these shingles may be weathered extensively, these cracks also may indicate a coating asphalt material defect.

(Effects of Weathering, Cont'd)

Photo 2.1.5 The most severe exposure is the southern. On this roof, the southern exposure (the right slope in the photo) had been replaced far in advance of the northern slope. Dark colored patches on the northern slope are algae that enjoy the moisture of the more sheltered exposure. Remember that each roof slope ages (or weathers) at a different rate due to its exposure.

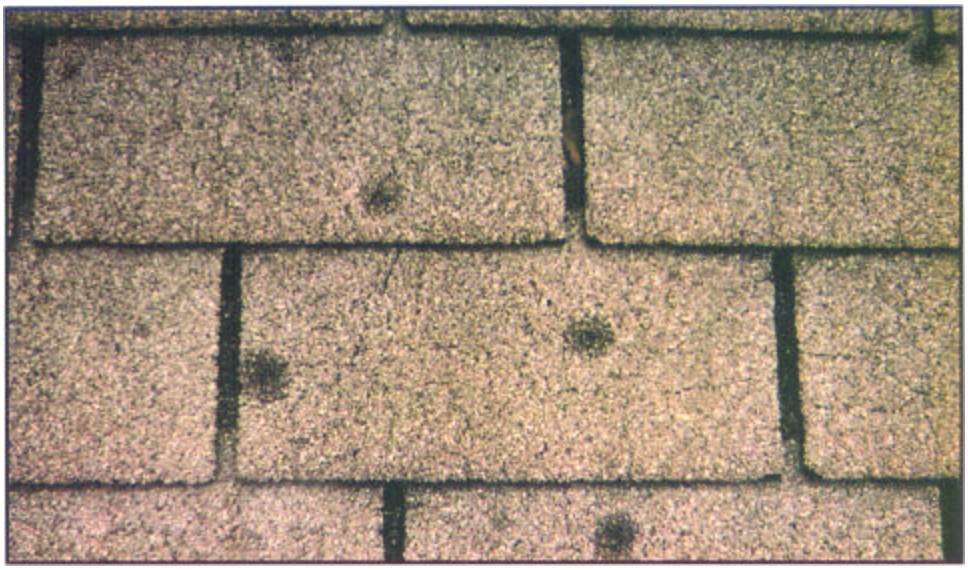

Photo 2.1.6 Algae may appear as a general darkening over large areas or in well defined spots such as shown here. Algae do not damage constituents of a composition roof; nonetheless, the presence of algae may be visually unpleasing.

(Effects of Weathering, Cont'd)

Photo 2.1.7 Organic debris promotes algae growth since it harbors moisture.

Photo 2.1.8 Shingles on these slopes are the same age; the attic space beneath the right slope was not vented (cathedral ceiling construction) whereas the attic space on the left was vented. Inadequate venting intensifies exposure effects by increasing roof material temperatures and accelerating the composition shingle aging process.

(Effects of Weathering, Cont'd)

Photo 2.1.9 Look closely to see horizontal cracks traversing the composition shingle tabs in this photo. Recall that each tab is fastened above by mechanical fasteners and below by self-sealing adhesive strips. Thermally induced strains have fractured the tabs, separating them from tops of the shingles at the line of least resistance.

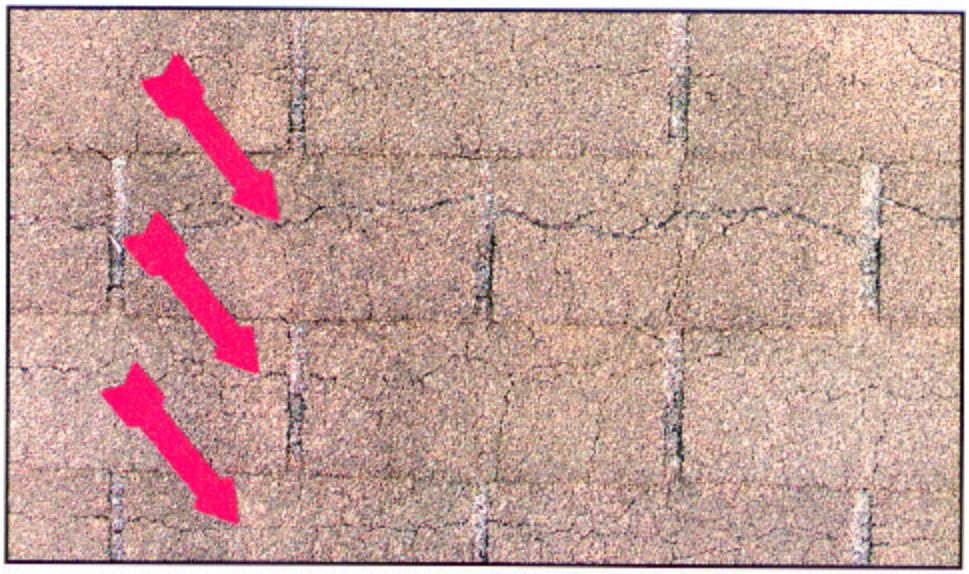

Photo 2.1.10 Close-up of horizontal cracks caused by thermal strains. This problem was not caused by wind effects.

(Effects of Weathering, Cont'd.

Photo 2.1.11 Decking distortions typically due to temperature and/or moisture can cause diagonal tears in the shingles, as on the slope of this roof. Severe foundation settlement problems also can cause such diagonal tearing.

Photo 2.1.12 In this close-up, we see a diagonal tear (induced by underlying deck movements) traversing the roof slope from bottom right to top left.

(Effects of Weathering, Cont'd.)

Photo 2.1.13 Close-up of composition shingle granules collected in gutter along roof eave.

Recall that granules shield the asphalt from sunlight, reflect heat, add color, and provide fire resistance. About one-third of the weight of composition shingles is granules. Thus, for a 210 pound composition roof, there are about 70 pounds of granules per square, or more than a ton of granules on a thirty-square roof.

Does hail cause granule loss? Yes, but it is highly unlikely that hailstone impacts cause significant granule loss. Granule loss may be likened to tire wear. Over the life of a roof (tire), granules (rubber) are lost continually. A sudden hailstorm (panic stop) reduces the quantity of granules (rubber) an insignificant amount. If this were not the case, after one hailstorm (panic stop), one should replace a roof (tire). In both cases, the result is negligible loss of life.

2.2 Manufacturing Defects

Photo 2.2.1 At the beginning of the manufacturing process, jumbo rolls of felt on reels are unwound into a dry looper (or accumulator) before application of the coating asphalt. When one reel empties and another is inserted, the felts are spliced. The splice region of felt is dissimilar to other areas and inherently weak as well. Therefore, a composition product containing a splice should be discarded (culled), never installed on a roof. This photo illustrates rapid deterioration typical of composition shingles which included a splice.

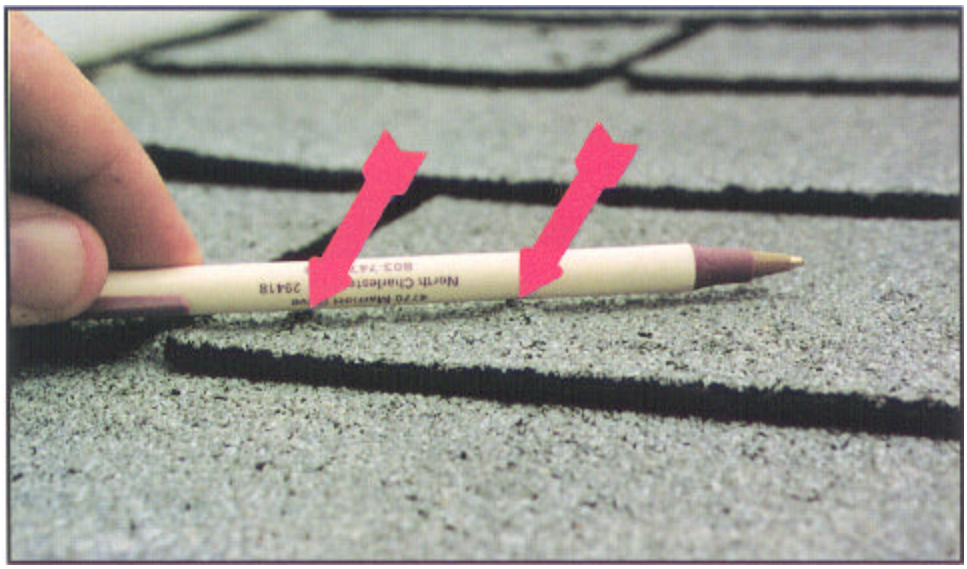

Photo 2.2.2 Granules are embedded into the coating asphalt of composition shingles. Collections of volatiles within the asphalt, once heated, vaporize, producing balloon-like forms known as blisters in the shingle surfaces.

(Manufacturing Defects, Cont'd.)

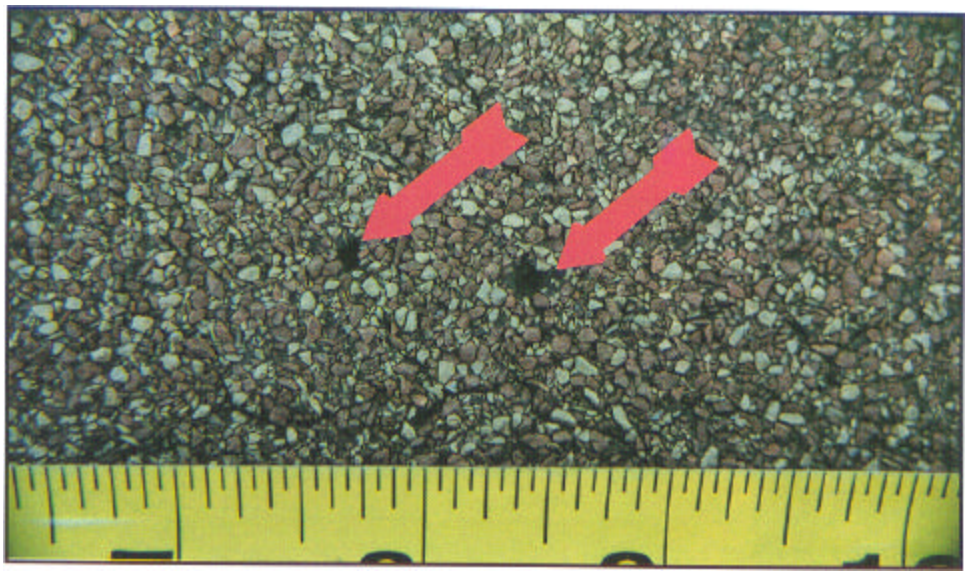

Photo 2.2.3 Over time, blisters rupture and expose underlying asphalt and felt. The exposed asphalt photooxidizes and leaves a water-soluble, light-colored, powdery material behind. The light-colored material is washed away by rain, and the cycle of deterioration resumes. Blisters are exacerbated by high roof membrane temperatures.

Photo 2.2.4 Another manufacturing defect. The repeated appearance of some unique shingle condition in a diagonal pattern on a roof, the result of standard application techniques, is definitive evidence of a manufacturing problem.

(Manufacturing Defects, Cont'd.)

Photo 2.2.5 Different batches of shingles are likely to have slightly different colors. Color differences are known as shading and, likewise, tend to appear in diagonal patterns on a roof.

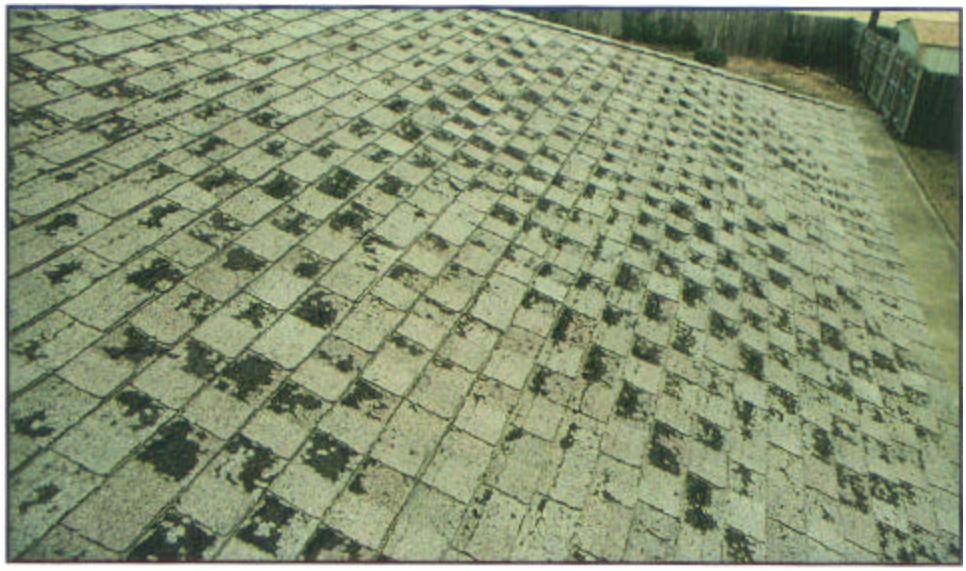

Photo 2.2.6 View of laminated (random-tab, multi-thickness) shingles with extensively deteriorated backer exposures (lower laminates) creating a "checker-board" appearance. Some of the more deteriorated shingles appear in diagonal patterns across the roof slope.

(Manufacturing Defects, Cont'd.)

Photo 2.2.7 Close-up of deteriorated backer shingle area depicted in Photo 2.2.6.

2.3 Installation Deficiencies

Photo 2.3.1 Nails and staples will migrate out of wood subjected to wet and dry cycles. Here we have a case in which a shingle has been buckled away from the roof by a withdrawn nail below. This problem also occurs if the fastener was not driven in flush when installed.

Photo 2.3.2 Close-up of the protruding nail beneath the shingle tab of Photo 2.3.1

(Installation Deficiencies, Cont'd.)

Photo 2.3.3 View of a weathered roof with holes in tabs caused by raised nail heads from below.

Photo 2.3.4 Shown here is a staple that has migrated through a tab from below. It has been our experience that shingles fastened with staples more frequently exhibit problems than those fastened with nails. Roofing nails are preferred over staples by the Asphalt Roofing Manufacturers Association (ARMA).

(Installation Deficiencies, Cont'd.)

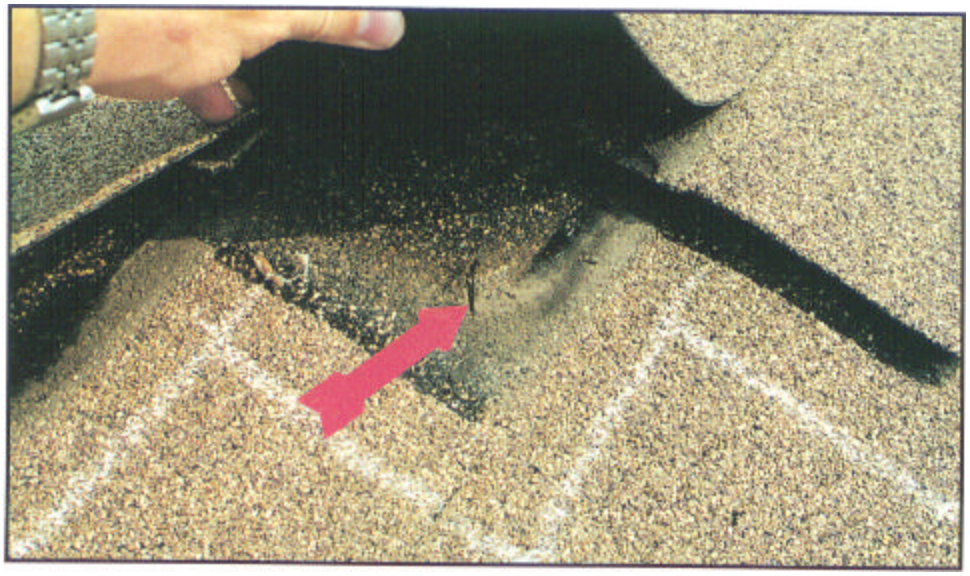

Photo 2.3.5 Close-up of overdriven staple that had cut through shingle.

Photo 2.3.6 Several shingle corners had been torn away by mechanical action

(Installation Deficiencies, Cont'd.)

Photo 2.3.7 Mechanical damage to these shingles was caused by a roofer trimming shingles without a cutting board.

(Hail-Caused Damage - Natural versus Artificial, Cont'd.)

Photo 2.4.1 Overview of a natural hailstone-impacted roof. Note the randomness and separation of the larger impact marks.

Photo 2.4.2 Close-up of Photo 2.4.1.

(Hail-Caused Damage - Natural versus Artificial, Cont'd.)

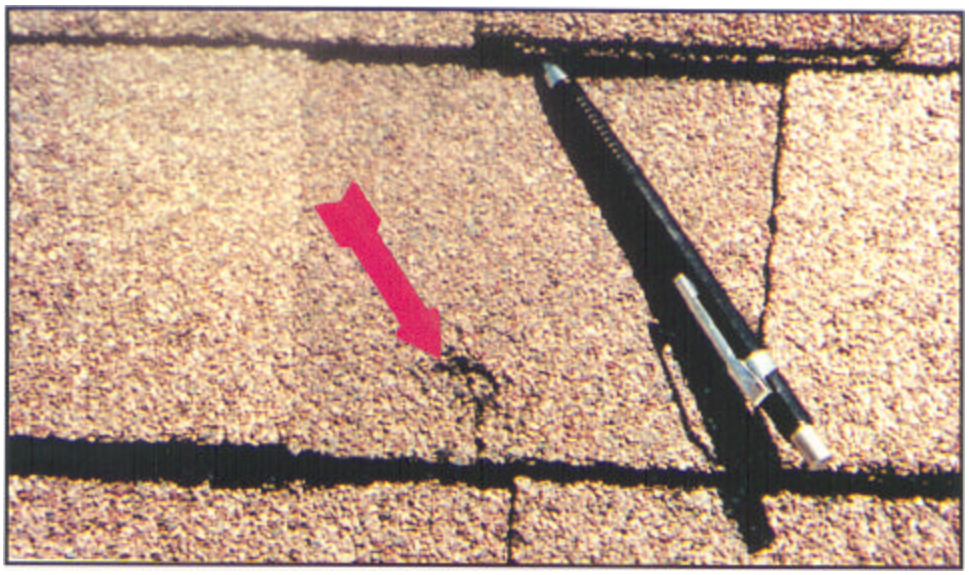

Photo 2.4.3 Close-up of another hailstone impact mark. Damage to light composition shingles generally does not occur until hard hailstones are greater than 1 inch in diameter. Heavier weight shingles generally are not damaged by hard hailstones less than 1-1/4 inches in diameter.

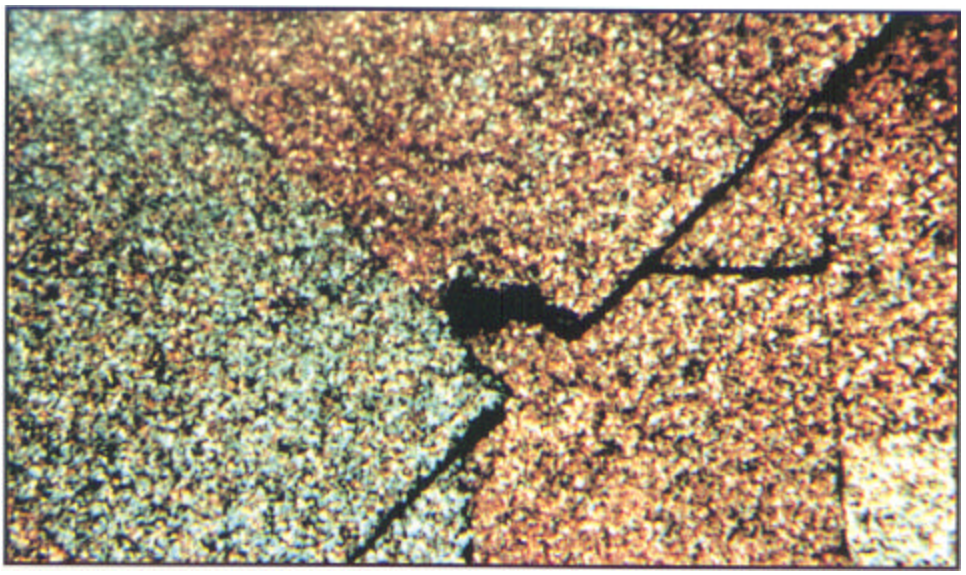

Photo 2.4.4 Unsupported shingles, those along eaves, rakes, ridges, or valleys, are more susceptible to damage from impact than those that are supported adequately. Shown is a ridge shingle from which the edge has been broken away by hailstone impact.

(Hail-Caused Damage - Natural versus Artificial, Cont'd.)

Photo 2.4.5 Close-up of bruises in ridge shingles caused by hailstone impacts.

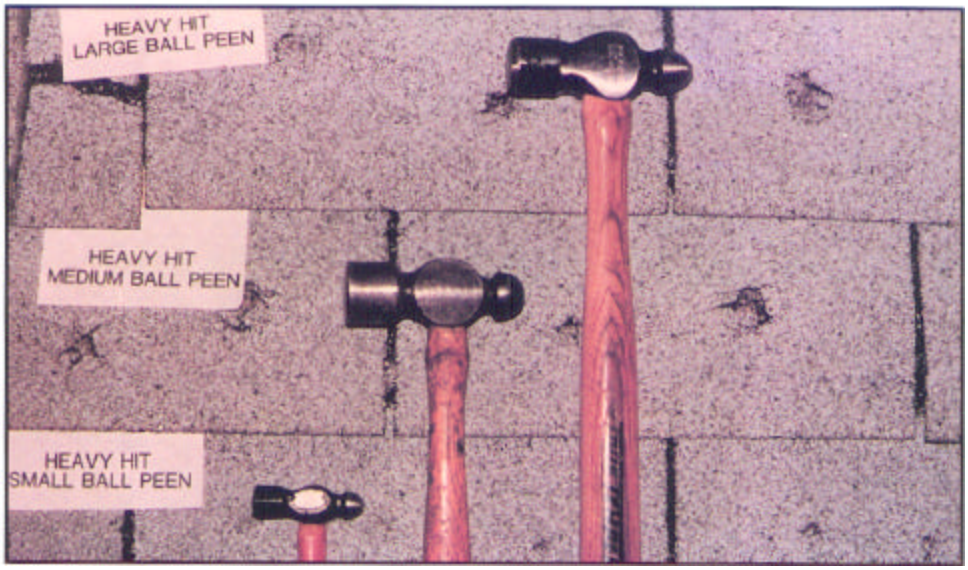

Photo 2.4.6 Haag Engineering Co. has conducted a study on the effects of ball peen hammers struck against not only western red cedar but also composition shingles. Pictured are hammers used in the Haag Ball Peen Test.

(Hail-Caused Damage - Natural versus Artificial, Cont'd.)

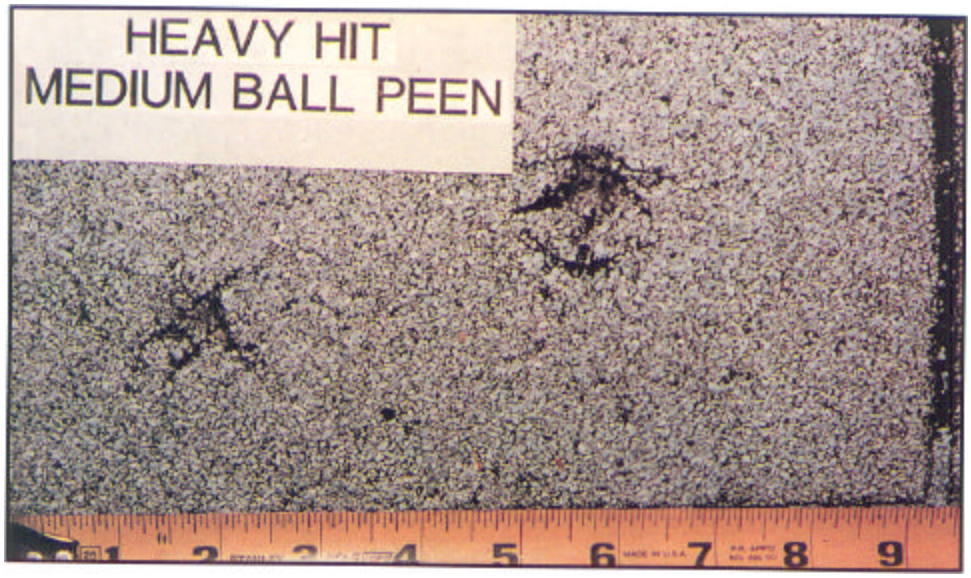

Photo 2.4.7 The Haag study demonstrated that sizes and shapes of marks depended on shapes and sizes of ball-shaped peens, blow intensities, and flexibility of the shingles. This is a close-up of a heavy hit intensity/medium ball peen hammer mark..

Photo 2.4.8 A composition roof impacted by "man-made hail." Note the regular distribution of identically sized marks.

(Hail-Caused Damage - Natural versus Artificial, Cont'd.)

Photo 2.4.9 A roof impacted by "artificial hail," perhaps the screwdriver variety.

Photo 2.4.10 Close-up of a star-like impact mark caused by a hammer blow.

(Hail-Caused Damage - Natural versus Artificial, Cont'd.)

Photo 2.4.11 Close-up of a hammer impact mark on a composition roof. Note that the granules have been crushed at the point of impact; granules cannot be crushed by naturally occurring hail.