HAIL DAMAGE STUDY

For Selected Buildings at

Texas A&M University

College Station, Texas

A Study of Roof Conditions Observed On Seven Campus Structures Following a Severe Hail Event on 3/15/2025

Prepared by

Roofing Industry Committee On Weather Issues (RICOWI)

RICOWI, Inc.

Roofing Industry Committee on Weather Issues, Inc.

TABLE OF CONTENTS

SECTION CONTENTS

RICOWI White Paper

Hail Damage Study

Date 01/07/2026

Prepared by Phil Mayfield – RICOWI Program Coordinator
Eric Olson, P.E. – RICOWI Storm Damage Investigator

Subject Hailstorm at Texas A&M University (TAMU), College Station, Texas

This white paper was prepared to present our findings following a site visit to the main campus of TAMU in April 2025, following a major weather event in College Station on or around March 15, 2025, the date of loss (DOL).

On April 8, 2025, a visual roof survey of seven TAMU buildings was conducted by two storm damage investigators from the Roofing Industry Committee On Weather Issues (RICOWI).

Our scope was to perform a visual survey, analyze relevant roof construction and conditions, and determine causation for any roof system anomalies observed during the inspection.

At the time of the inspections, weather was cool, partly cloudy, and with light winds. Roof access was coordinated by members of Brazos Urethane, a Texas contractor that has completed numerous campus roofing projects. Our investigation did not include any destructive inspection or testing.

If additional information becomes available, RICOWI reserves the right to revise and republish it.

Respectfully yours,

Phil Mayfield – RICOWI Program Coordinator

Eric Olson, P.E. – RICOWI Investigator

INTRODUCTION

RICOWI was invited to inspect roofs on the Texas A & M University College Station campus following a major thunderstorm in March 2025. Representing RICOWI were Phil Mayfield and Eric Olson, both experienced storm investigators. The purpose of the inspections was to identify damage that occurred during the storm and offer opinions on the nature and cause of anomalies.

Our findings and opinions are based, in part, on the following:

- Observations during rooftop inspections on April 8, 2025
- Review of third-party weather data from third-party sources
- Interviews with campus personnel and their roofing contractor (Brazos Urethane)
- Decades of storm damage investigation experience

The March 15, 2025, weather in and around College Station, Texas, included a thunderstorm containing large hail, which caused widespread roof damage to both older and newer roofs at subject campus. As a result, subject property required extensive remedial work.

Our investigation documented visible evidence of hail e.g., spatter and deformed metal, in some cases indicating dozens of hits per 100 square feet. In addition to those anomalies, which are sometimes considered cosmetic issues, functional roof damage was observed on several buildings, including the following structures inspected by our team.

1. PETERSON BUILDING
2. LIBERAL ARTS & HUMANITIES
3. ENGINEERING ACTIVITIES, BUILDING A
4. SCOATES HALL
5. BLOCKER BUILDING
6. GENERAL SERVICES COMPLEX, BUILDING 1800
7. CLEMENTS RESIDENCE HALL

As with most hailstorms, there was a mixture of hail sizes and impact frequency (number of hits per 100 square feet) on the March 15, 2025, date of loss (DOL), not only on different buildings, but even on the same roof. Our photos document hailstone sizes of approximately 1.0 to 2.25 inches, which correlates to third-party reports by hail-tracking sources.

Of the seven structures, roof covering materials included:

- Spray polyurethane foam (SPF)
- Modified bituminous (MB) membranes

- Asphalt architectural shingles
- Standing seam (SS) metal, both prefinished steel and copper panels

Most documented damage did not exhibit signs of inadequate design, installation, or maintenance, which might otherwise be considered as potential causes. One MB-covered roof exhibited normal age-related granule loss on plies that also exhibited impact-related granule loss. The impact-related damage was characterized by circular areas approximately two-inches in diameter devoid of granules. Because “normal,” age-related granule loss is sometimes conflated with damage from severe hail, we provided guidelines under OBSERVATIONS (page 9) to visually differentiate the two. Some roof consultants have suggested that sub-severe hail (smaller than one inch diameter) may cause granule loss similar in appearance to that caused by natural age and weathering. Regardless of the cause of gradual granule loss, it appears as a fairly widespread and homogenous condition, visually, rather than as conspicuous dark spots against an otherwise uniformly colored and shaded background.

One interesting observation had to do with the composition of SPF assemblies, and the resulting effect on impact resistance. Based on years of experience with foam roofs, TAMU had adopted an SPF assembly consisting of polyurethane foam coated with both silicone and polyurea and topped with mineral granules. Proof of the improved hail resistance of that upgraded system was apparent when we inspected an SPF roof coated with silicone but not polyurea; it exhibited significant and widespread damage not found on SPF roofs covered with both coatings. On another SPF roof, patches with silicone-coated SPF, but without polyurea, exhibited moderate damage while the surrounding upgraded system exhibited no impact damage.

INVESTIGATIVE METHODOLOGY

When surveying the building envelope, it is important to do so in a fair, honest, and impartial manner, considering all relevant factors, in the spirit of the Scientific Method*. Effective analysis is a combination of education, training, experience, and unbiased professional judgment.

RICOWI investigators attempt to consider each of the following when evaluating building envelopes and analyzing anomalies.

- CONSTRUCTION – This includes not only the type of materials used, but how they are installed and what role they play in preventing infiltration of air and moisture.
- AGE – Building age and roof age can both influence the performance of the building envelope.
- RELEVANT HISTORY – Has building usage changed? Has it been enlarged, causing structural alterations? Has the building envelope been damaged? Has the roof been replaced or repaired?
- DETERIORATION vs TRAUMA – Are existing anomalies due to natural deterioration or due to trauma (impact damage)? If the latter, is it more likely weather-related, or man-made abuse?
- ENVIRONMENT – Not only ambient weather, but also proximity to trees, salt spray, or other possible damage sources.
- MAINTENANCE – Has the building envelope been adequately maintained? Are the observed anomalies or leaks due to inadequate maintenance? If so, how?
- EXCLUDING DAMAGE CAUSES – What possible causes can be plausibly excluded?

* Scientific Method

1. Observation
2. Formulation of a question
3. Hypothesis
4. Prediction
5. Testing
6. Analysis

ROOF CONSTRUCTION OVERVIEW

As with most large campuses, Texas A&M University (TAMU) buildings were covered with a variety of types of roofing systems e.g., graveled built-up roof membranes (BURMs), modified bituminous (MB) membranes, spray polyurethane foam (SPF), single-ply thermoplastic polyolefin (TPO) membranes, asphalt shingles, and various types of metal roofing – both standing seam and through-fastened panels.

Below is a breakdown of TAMU's preferred roof system, as described to us by Buddy Beamon (TAMU's Construction Project Manager for SSC Services). It is what will be referred to herein as the "**Standard TAMU SPF System**" (STSS) and consists of, from the top down:

- Mineral granules (embedded)
- Silicone coating (20-mil base layer plus 20-mil top layer)
- Polyurea coating (50-mil layer)
- Spray polyurethane foam (thickness varies)

This system is typically applied directly over steel or structural concrete decking, although some installations at this campus were installed directly on top of older built-up roof membranes (BURMs). The STSS has evolved over the decades to produce a system that, according to TAMU, has excellent adhesion, waterproofing efficacy, and durability, and stands up well to foot traffic, wind, and hail.

All but one of the roofs on the seven buildings surveyed by RICOWI investigators were low-slope ("flat") commercial-type design bordered by parapets and utilizing roof drains and/or scuppers to facilitate drainage. The lone exception was the Engineering Activities Building A, which incorporated steep-slope design in both its main roof and the intersecting wings.

Below are listed the seven buildings focused on during RICOWI site visits, and their respective roof systems, in chronological order.

1. **PETERSON BUILDING**
    - The week of the hail event, Brazos Urethane was installing STSS on these roofs. SPF had been installed and primed but had not yet been coated with polyurea/silicone/granules as of the DOL.
2. **LIBERAL ARTS & HUMANITIES**
    - Standard TAMU SPF system completed one day before DOL.
3. **ENGINEERING ACTIVITIES, BUILDING A**
    - Main building: asphalt architectural shingles reportedly six years old.
    - Intersecting wings: prefinished steel standing seam panels.

4. **SCOATES HALL**
    - TPO system reportedly installed around 2011 (approximately 14 years old).
5. **BLOCKER BUILDING**
    - SPF covered with granules and a 30-mil silicone coating; approximately five years old.
6. **GENERAL SERVICES COMPLEX, BUILDING 1800**
    - Mineral-surfaced styrene butadiene styrene (hot-mopped with asphalt) MB system, estimated by TAMU staff to be approximately 12-15 years old.
    - This building was not in the epicenter of the hailstorm, it was about one mile WNW of the main campus, where hail size appeared to be smaller than on the main campus.
7. **CLEMENTS RESIDENCE HALL**
    - Standard TAMU SPF system except relatively recent patches using SPF covered in granules and silicone, but not polyurea. The patches were installed prior to the DOL.

End of Roof Construction Overview

OBSERVATIONS

During our site visit we observed the following conditions.

1. **Hail Spatter** – Surfaces of some of the older roofs, as well as smooth metal and concrete surfaces, exhibited a phenomenon known as spatter. Spatter appears as round/oblong clean spots on otherwise dusty or contaminated surfaces.

   The condition is the result of hailstone impact, which temporarily detaches enough contaminants to leave visible spots the same general size and shape as the hailstones causing them. Spatter may remain visible for several months but typically fades within a year or less. However, depending how clean the surface is, there may be no spatter, even with heavy hailfall.

   Spatter shape may also provide clues as to the direction of hailfall. This condition is consistent with the hailstorm on the date of loss (DOL).

2. **Deformed/Dented Metal** – Some metal roof panels, coping, exhaust units, and flashing exhibited deformation i.e., crushing and indentations consistent with traumatic impact from hail. The anomalies were of different sizes, corresponding with the variety of hailstone sizes from the storm on the DOL.

3. **Age-related Granule Loss** – Asphaltic membranes and shingles with embedded mineral granules often begin experiencing granule loss after ten or more years of weather exposure. Older MB Membranes such as those covering the General Services Complex Building 1800, and asphalt architectural shingles, such as those on the Engineering Activities Building A, both exhibited signs of this kind of gradual granule loss from normal age and weathering. The visible evidence is slight darkening of the surfaces as colored minerals are lost, allowing black asphalt to show through. As granules are lost, underlying asphalt is exposed to greater amounts of UV light, causing oxidation of the asphalt and accelerated aging of the membrane.

4. **MB Impact Damage –** Modified bituminous membranes exhibited many dark round spots typical of what happens when granules are detached by traumatic impact from hail. When the protective granules become detached, the underlying black asphalt is exposed to UV damage from sunlight, causing premature deterioration – from oxidation - and shortened service life.

   The main visible difference in age-related granule loss and granules detached from impact damage (Item 3) is that the overall appearance of the former is relatively uniform, whereas the latter displays a pockmarked appearance, with generally round dark blotches amid an otherwise white/grey background.

5. **Asphalt Shingle Impact Damage** – Shingles covering portions of the Engineering Activities Building A roof exhibited widespread gouges and/or bruises consistent with traumatic impact from hail on the DOL. For purposes of this report, a bruise is defined as a soft spot caused by traumatic impact and a gouge includes scraping (of granules), fracturing, or detachment of a portion of the shingle. Hail size appeared to be larger than one inch in diameter, which is the threshold for what is considered "severe" hail. It was not clear if mats were split or otherwise breached, but the loss of granules caused immediate exposure of underlying asphalt to UV damage.

6. **SPF Impact Damage –** There were mixed results on various foam-covered roofs, depending on the SPF system composition. Roofs covered with the STSS that had fully cured exhibited virtually no impact damage. The Liberal Arts Building exhibited some soft spot and/or "cratering" that may have occurred due to the STSS not being completely cured.

   On the Peterson Building roof, however, the SPF exhibited widespread impact damage because it had not yet been coated with silicone, polyurea, or granules.

   On the roof of Clements Residence Hall, rectangular patches applied prior to the DOL and coated with silicone and granules, but without polyurea, also exhibited impact damage; damage not observed elsewhere on STSS-covered areas.

End of Observations

WEATHER CONSIDERATIONS

The most common and expensive form of destructive weather event in North America is severe hail, accounting for almost 70% of the property damage in insurance claims from severe storms[1]. Many investigations and studies have been completed on the effects of hail on roof membranes and appurtenances. According to The Weather Company[2], “Since most significant hail damage to property and crops comes from hailstones at least one inch in diameter, hail of that size is considered severe.” Hail was the primary weather consideration on the date of loss at the subject locations. According to third-party weather reporting service StormerSite[3], hail up to three inches in diameter was reported on or near the campus on March 15, 2025, the date of loss (DOL).

Hail damage is a factor of kinetic (impact) energy, which is a function of hailstone diameter, mass, speed, and direction, as well as the physical characteristics of the roofing material. Impact energy may be calculated with this formula: **Kinetic or Impact Energy (K_e) = ½(mass)(velocity)**. Using the formula[4], the following chart shows various hail sizes, velocity, and resulting impact energy.

Size Description	Diameter	Free-Fall Velocity	Free-Fall Velocity	Impact Energy
National Weather Service	Inches	ft/sec	miles/hr	ft-lbs
Pea	0.25	36	24	0.005
Marble/Mothball	0.50	50	34	0.086
Dime/Penny	0.75	62	42	0.439
Quarter (NWS Severe Criteria)	1.00	73	50	1.44 ←
Half Dollar	1.25	82	56	4
Ping Pong Ball	1.50	90	61	7
Golf Ball	1.75	97	66	14 ←
Hen Egg	2.00	105	72	24 ←
Billiard Ball	2.25	112	76	39
Tennis Ball	2.5	117	80	58
Baseball	2.75	124	85	87
Tea Cup	3.00	130	89	124
Softball	4.00	143	97	353

Figure 1: A chart shows the correlation between hailstone size (diameter), velocity, and impact energy. Impact energy increases exponentially, with hail size. Note that when hailstone diameter increases by just 75%, from 1-inch to 1.75-inches, the impact energy is nearly tenfold, and 2-inch hail produces approximately 16 times the impact energy of 1-inch (“severe”) hail.

---

[1] **IBHS**
[2] **The Weather Company**
[3] **StormerSite**
[4] **Coyne**

As described on the previous page, hail damage is a factor of kinetic energy, as well as the physical characteristics of the affected roofing materials. However, hailstone density/hardness varies. Slushy hail will not cause the same damage as a dense/hard hailstone of similar size and weight. Hard hailstones with sharp spikes may cause more damage than smooth, round hailstones.

Further, freefall speeds and hailstone sizes indicated in the impact energy chart (Figure 1) are based on laboratory testing of spheres rather than actual hailstones like those shown in Figure 2 and Figure 3. More recent wind tunnel testing using artificial hailstones with shapes and densities based on newer analysis and models created by 3D copiers have shown slight differences in freefall speed, and therefore, impact energy, compared to what was previously indicated.[5] For that reason, the impact energy chart in should be viewed as a general guideline and not accepted as absolute.

Figure 2: Varying hail sizes and shapes (smooth, jagged, spiked) from a single storm. (The Weather Network [6])

Figure 3: More photos of hail from a single storm. Note the variety of small, large, smooth, and jagged hailstones. (KSAT TV [7]).

---

[5] **Heumsfield, et al**
[6] **TWN**
[7] **KSAT**

WEATHER SUMMARY

On or around March 15, 2025, College Station, Texas experienced thunderstorms containing unusually large hail. Figure 4 is a StormerSite map showing storm cells with hail sizes up to three inches in diameter, with the Texas A&M campus within the encircled area.

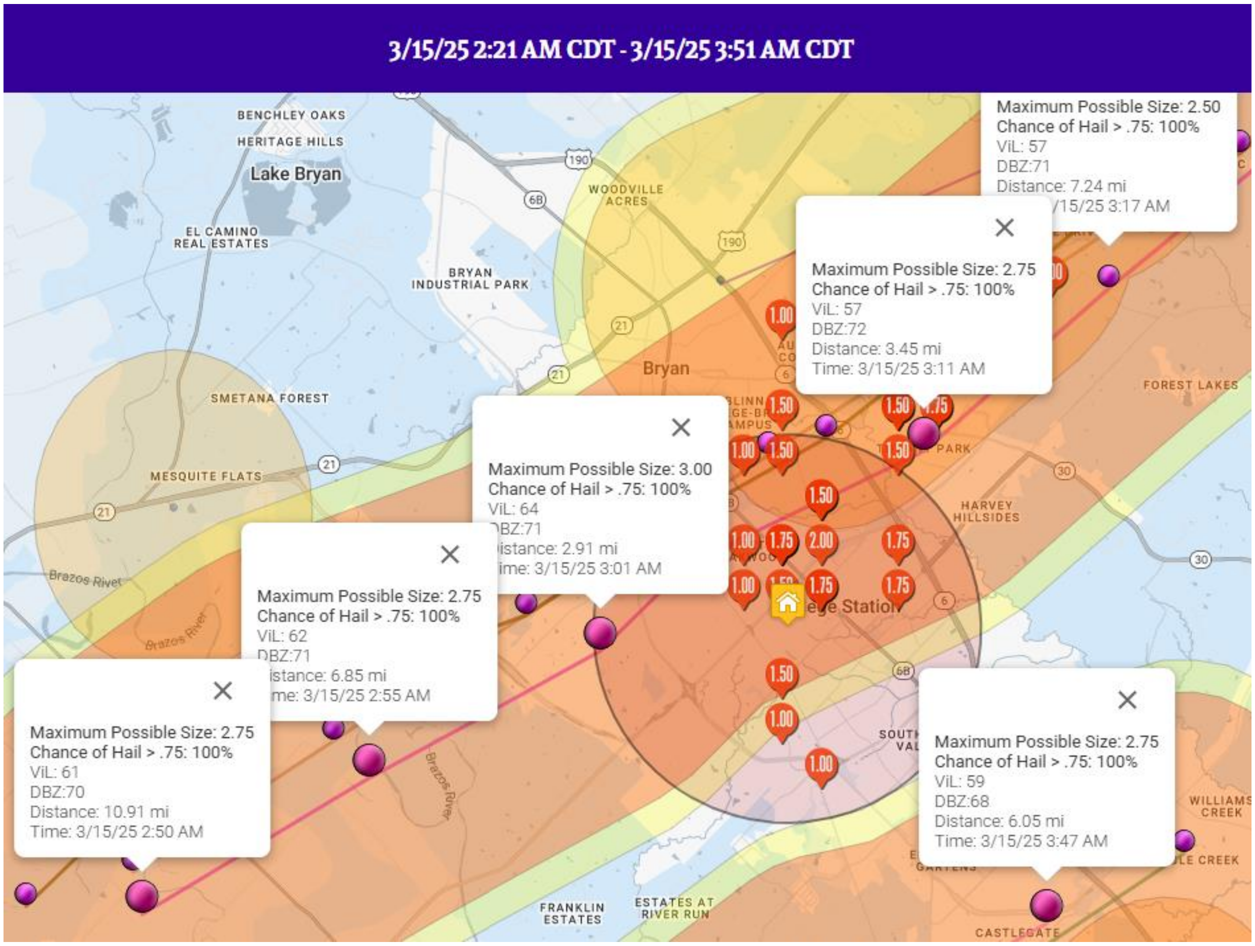

Figure 4: A map showing hail sizes up to three inches in diameter in a line of thunderstorms, with the campus within the encircled area in the path. At the center of the circle, a yellow-white house symbol represents Peterson Hall, one of the buildings inspected by RICOWI.

In the Figure 4 graphic, red circles show hail sizes reported by people on the ground at those locations. It is not unusual for on-site reports to indicate hail sizes slightly larger or smaller than those estimated by third-party storm tracking services like NOAA or StormerSite.

Figure 5 is a graphic from the NOAA's Severe Weather Data Inventory (SWDI[8]) showing storm cells that moved through College Station on the March 15, 2025, DOL. The blue dots are data points associated with individual storm cells. These data rely on radar and algorithms that combine to provide a fairly accurate picture of the weather along the storm's route.

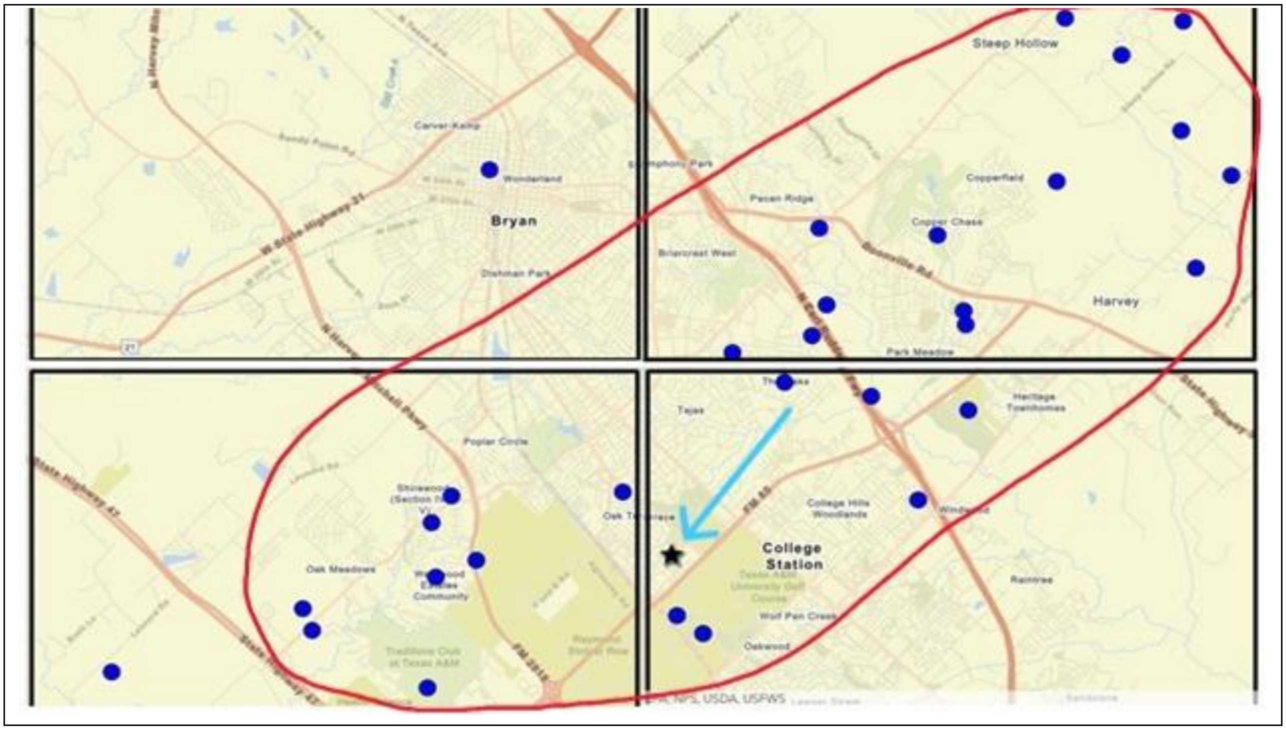

Figure 5: A NOAA/SWDI Map shows the area with hail sizes up to 3.0 inches in diameter in a line of thunderstorms (encircled in red). Peterson Hall – near the center of the campus – is shown by a black star (blue arrow) in the path.

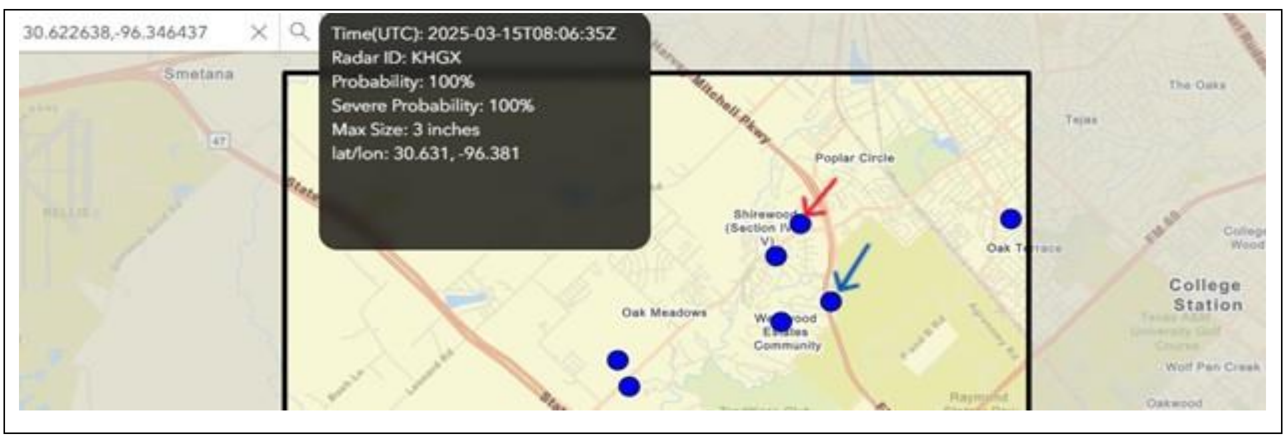

Figure 6: A closer view of the lower left quadrant of the Figure 5 map. A red arrow points to where 3-inch hail was reported. A blue arrow highlights where 2.75-inch hail was reported.

[8] **SWDI**

DISCUSSION

Our investigation focused on damage to the following types of roofing materials covering seven TAMU buildings.

1. **Sprayed Polyurethane Foam (SPF) Assemblies** – The STSS favored by TAMU consists of two or more layers/lifts of SPF installed over a structural decking system (or existing bituminous roof assembly). On top of the SPF is a 50-mil layer of polyurea, two 20-mil layers of silicone, and topping of embedded mineral granules. This system has proven to the satisfaction of TAMU officials to be cost effective, very durable, and relatively easy to maintain.

   In one case (Clements Residence Hall), SPF patches were applied to the standard system but without the polyurea layer. Interestingly, of the handful of hail-caused breaches, all but one were found on the patches. This suggests that the addition of polyurea provided enhanced impact resistance.

   In another case (Peterson Building), the foam had been applied to the deck but neither liquid coating had been applied because work was interrupted by the hailstorm. All three sections (separated by curbed expansion joints) exhibited some of the worst hail damage of all buildings inspected. Damage consisted of circular or arched fractures and/or holes through the SPF surface.

   Even when the SPF assemblies were breached, the depth of holes/fractures appeared to be less than half the overall thickness of the SPF assemblies. Thus, even though rainwater was provided pathways into the foam itself, the dense, closed-cell construction of SPF minimized the length of those pathways, and appeared to prevent rainwater from infiltrating beyond the impact point. This also limited the damage to decking, substrate materials, and interior spaces, which so often magnifies the damage and costs of hail damage insurance claims.

   SPF assemblies exhibiting cuts, punctures, and other breaches of an SPF assembly can be repaired if done quickly, before entrapped moisture is allowed to migrate. Delays in remedial work risk UV damage to underlying foam and moisture migration to underlying fasteners, decking, structural walls, and interior spaces, compounding the problem.

2. **Modified Bituminous (MB) Assemblies** – MB roofing has generally been viewed as an upgraded form of asphalt built-up roofing (BUR). Both utilize asphalt as both the adhesive and the waterproofing bitumen; both consist of two or more plies; both utilize glass

and/or polyester felts; and both may be surfaced with some type of aggregate to enhance both UV protection and hail resistance. The biggest difference is the asphalt used for MB systems, compared to that used for most BUR systems.

When a relatively small amount of styrene butadiene styrene (SBS) or atactic polypropylene (APP) rubber is factory mixed with asphalt, the result is a batch of rubber-modified asphalt bitumen with greater elongation and elasticity than ordinary asphalt. Those two properties translate to greater resistance to hail impact and an overall more durable membrane.

The General Services Complex Building 1800 was on the outskirts of the campus and may not have been exposed to hail as large as the central campus area. The MB assembly covering the lower level appeared to be relatively old, yet survived the hail very well, aside from granule loss. Impact-caused granule loss exposes the underlying asphalt to ultraviolet light, which causes oxidation. Oxidation is a relatively slow form of premature deterioration and cannot be reversed, although it can be halted by restoring the MB surfaces with a UV-resistant coating, either alone or with embedded aggregate. When hail is large enough (size varies depending on condition of MB plies), the reinforcing scrim/mat may become fractured, further accelerating damage, although even without fractures, granule loss is damage that can result in a shortened service life.

3. **Asphalt Architectural Shingles** – When subjected to large hail, shingles will generally exhibit cuts, punctures, tears, and/or granule loss, as well as creased or detached tabs from exposure to the accompanying storm winds.

   The shingles used on portions of the Engineering Activities Building A roof exhibited fractures, exposed fibers, bruises, and gouges, due to the large hail size. Damage was widespread and severe enough that it warranted removal and re-roofing.

   Based on our experience, the size of hail on the DOL more than likely caused fracturing of many of these shingles, a condition that cannot be confirmed without removing a few tabs to examine the reverse (bottom) sides for fractures. It is possible that the shingles may continue to shed water more or less adequately even with fractured mats, although the hidden damage would almost certainly cause shortening of the roof service life.

4. **Thermoplastic Polyolefin (TPO) Assemblies** – Their natural flexibility and elongation make TPO membranes fairly resilient but may be punctured or torn depending on membrane age, condition, and impact energy of hailstones. Further, even when TPO

appears undamaged, other than “divots” or low spots from hail impact, underlying insulation can be partially crushed from the traumatic impact of large hail. In that case, there may be small voids between membrane and insulation, adversely affecting TPO support, as well as insulation thermal efficacy (R-value). It should be noted that our survey did not include destructive testing or inspection of the underside of TPO or other membranes, where otherwise hidden fractures are sometimes visible.

The TPO roof on Scoates Hall exhibited widespread spatter but did not sustain observable damage or fracturing of the top surface. This roof had likely been exposed to the severe hail that passed through this area on 4/8/2021 and 5/7/2020, also without observed surface damage, according to TAMU staff.

5. **Standing Seam (SS) Metal Panels** – When flat, smooth metal panels are subjected to traumatic impact from hail or other hard/sharp objects, damage can range from small dents to crushed ribs. When impact energy is strong enough, what appears to be a cosmetic anomaly may be functional damage if the factory-applied protective coating/paint is fractured. Damage to the coating is often not visible to the naked eye but may be detected when tested in a metallurgical laboratory (no testing was performed as part of this hail damage study). Damage to the coating can significantly accelerate corrosion, which may shorten roof service life, depending on the coating system and the type of metal. However, slight deformation forming gradual bends (“craters” or “divots”), rather than sharp bends, may not cause any more stress on factory coatings than the process of creating flutes and ribs in the manufacturing process.

CONCLUSIONS

The local weather on the DOL was a severe test of roofing materials of all types. Multiple storm cells containing large hail caused functional damage to all inspected buildings on the TAMU campus. As is often the case with multiple hail cells, hailstone size and hailfall density varied from one building to the next.

Because the strength and durability of most roofing materials gradually decline with age and weather exposure, older materials generally exhibit more visible and significant damage from hail impact than newer products. Those differences were especially apparent when inspecting older and newer SPF roofs and older and newer MB roofs.

Weather on the date of loss presented an opportunity to compare different varieties of SPF assemblies. It was obvious that SPF durability was demonstrably enhanced when coated with both polyurea and silicone, as compared to silicone alone. The addition of polyurea likely imparted that additional resilience.

End of Written Report

PHOTOS

On the following pages are photos of roof construction and conditions in evidence during our site investigation. Photos are arranged in the following order of inspection:

1. **PETERSON BUILDING**
   - The week of the hail event, Brazos Urethane was in the process of installing the “Standard TAMU SPF System” (STSS) - from the top, down: granules, silicone coating, polyurea coating, and sprayed polyurethane foam to the structural deck (typically structural concrete or steel).
   - SPF was completed but not yet coated with polyurea/silicone/granules as of the DOL.
2. **LIBERAL ARTS & HUMANITIES**
   - The STSS was completed one day before the DOL.
3. **ENGINEERING ACTIVITIES, BUILDING A**
   - Asphalt architectural shingles - appeared to be at least 8-10 years old
   - Prefinished steel standing seam panels
   - Copper ancillary components
4. **SCOATES HALL**
   - TPO system installed around 2011
5. **BLOCKER BUILDING**
   - SPF system with 30-mil silicone coating and granules, approximately five years old
6. **GENERAL SERVICES COMPLEX, BUILDING 1800**
   - Mineral-surfaced MB system (styrene butadiene styrene – hot-mopped plies), estimated to be at least 12-15 years old
7. **CLEMENTS HALL**
   - Standard TAMU SPF system except relatively recent SPF repairs (installed prior to the DOL) that did not include polyurea i.e., only silicone plus granules

PETERSON BUILDING

Photo 1: A wide-angle view of the NW end of the nearly completed Peterson Building SPF roof, which was divided into three sections separated by curbed expansion joints. This end was the only one covered with granules on the 3/15/2025 date of loss (DOL).

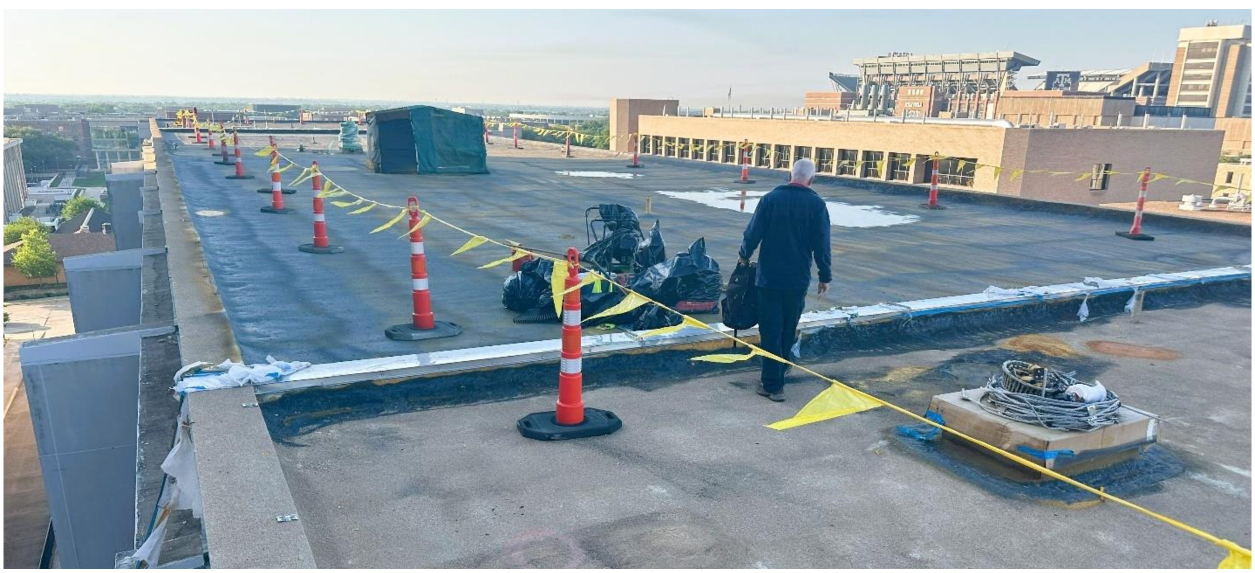

Photo 2: A NW-to-SE view of the other two sections, which were covered with SPF but had not yet been coated with polyurea, silicone, and granules.

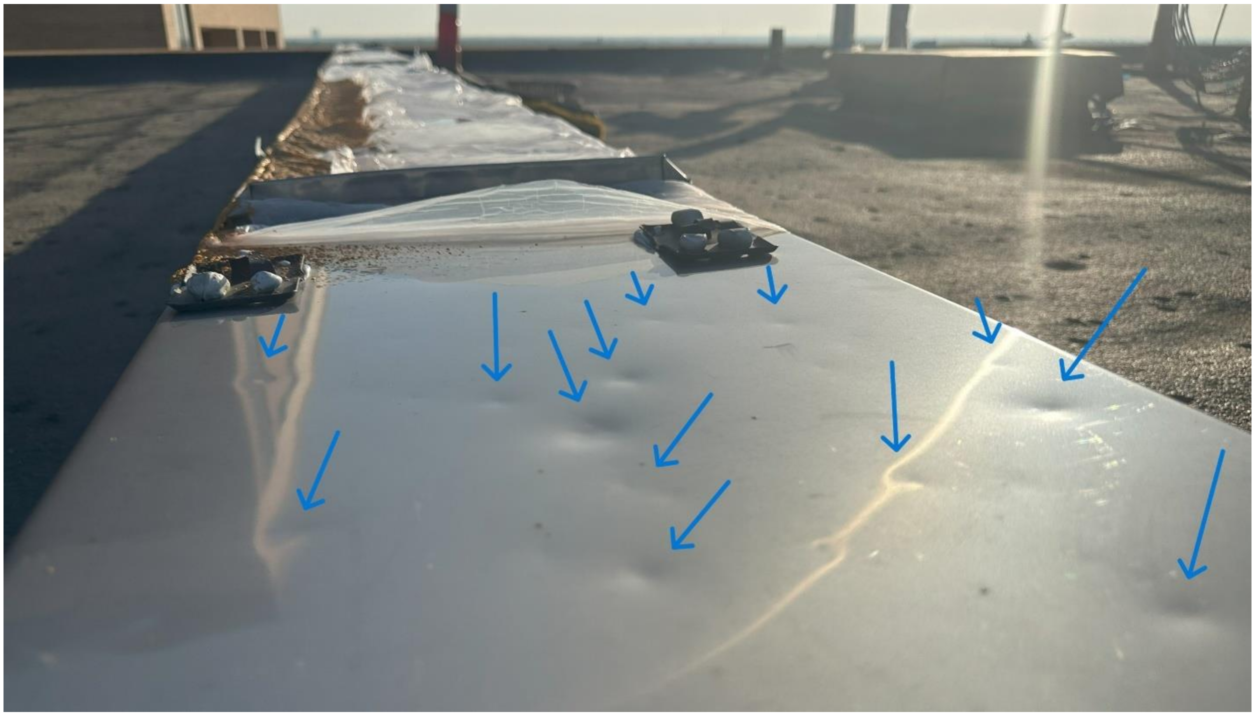

Photo 3: Arrows highlight widespread dents in the metal coping, indicating one-inch diameter ("severe") or larger hailstone impact.

Photo 4: A close-up view of one of the larger dents consistent with two-inch or larger hail.

Photo 5: Both photos on this page show heavily pock-marked SPF in the field of the center section, which had not been coated.

Photo 6

Photo 7: Both photos on this page are closer views of breached SPF that had not been coated as of the DOL.

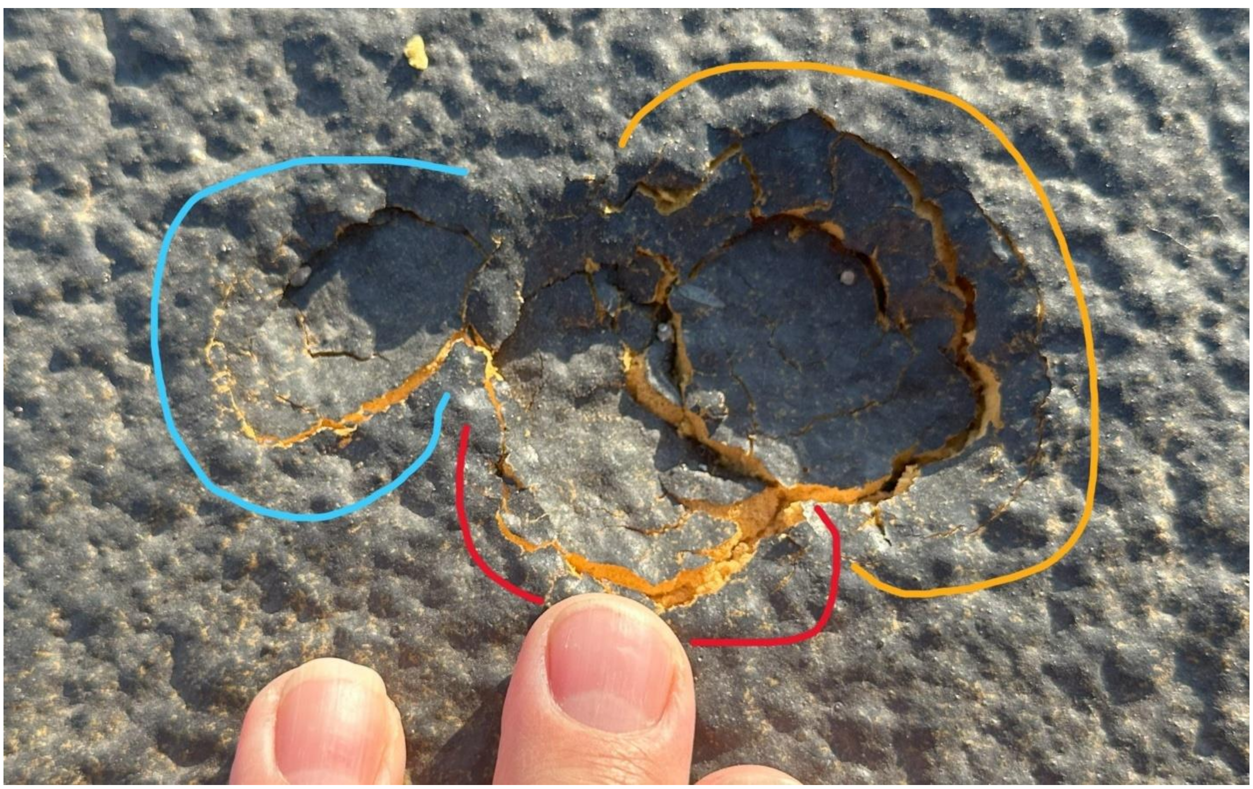

Photo 8: Blue, red, and yellow highlights indicate three different impact marks. It is not uncommon for two or more hail hits to combine impact energy and create openings that a single hailstone would not have caused.

Photo 9: Hailstone openings on SPF roofs are typically close to the size of the hailstones causing damage. In this case, hailstone size was estimated to be close to two inches in diameter.

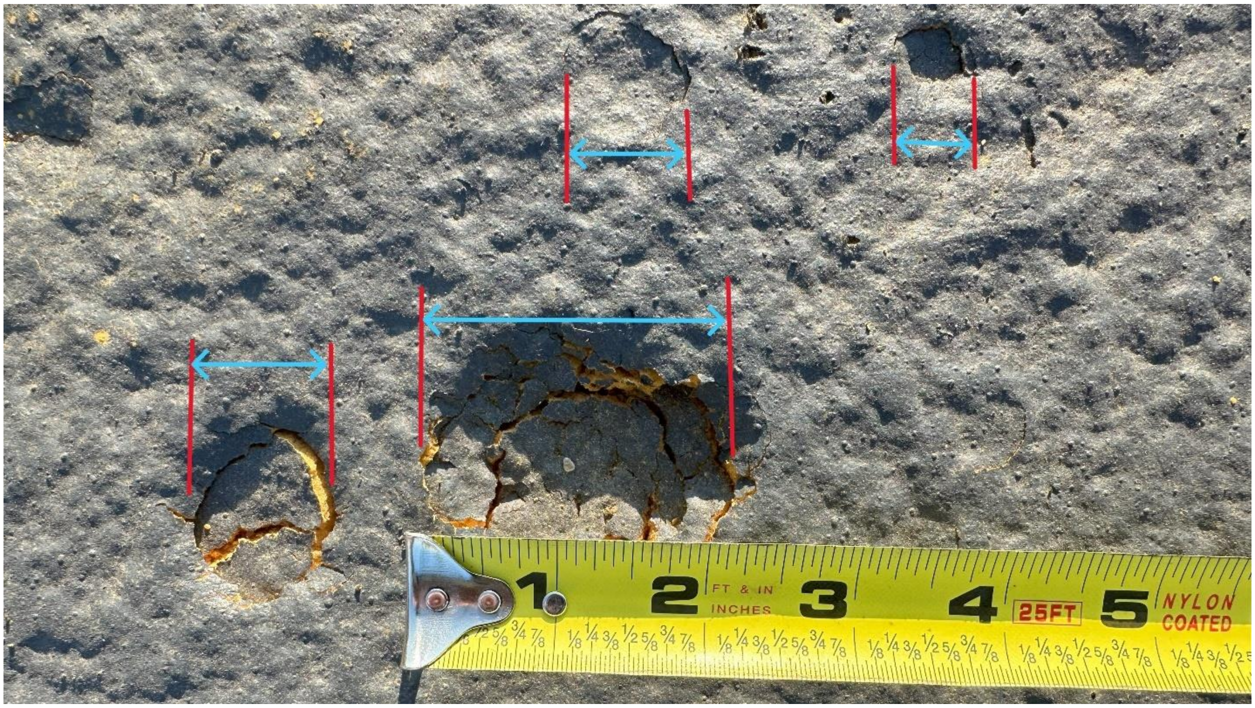

Photo 10: Both photos on this page are close-up views showing that hailstone sizes can vary from small to large from the same hail cells.

Photo 11

COLLEGE of LIBERAL ARTS & HUMANITIES (LAH)

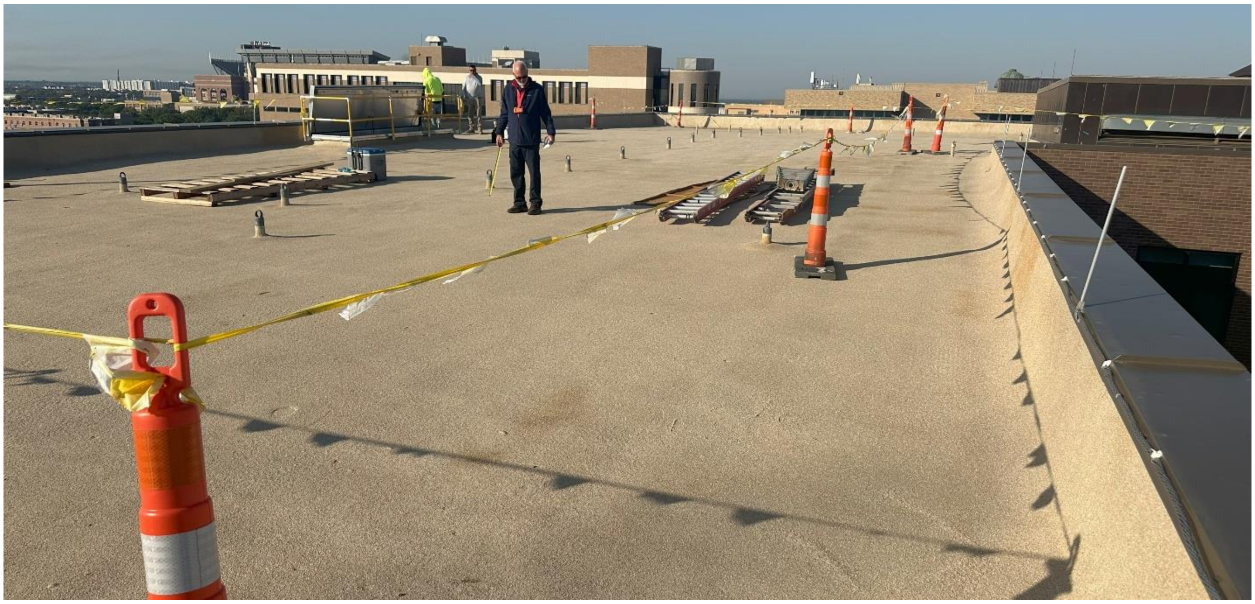

Photo 1: The LAH building roofing project was completed just one day before the 3/15/2025 DOL. It was the typical SPF system preferred by TAMU - From the top, down: granules, silicone coating, polyurea coating, sprayed polyurethane foam, and structural roof deck.

Photo 2: A wide-angle view of a raised portion of the CLAH roof, approximately four feet higher than the main roof.

Photo 3: Multiple hail hits are visible at this juncture of intersecting metal coping sections.

Photo 4: Arrows highlight large indentations on metal counterflashing indicating hail 1-3/4-inches in diameter or larger.

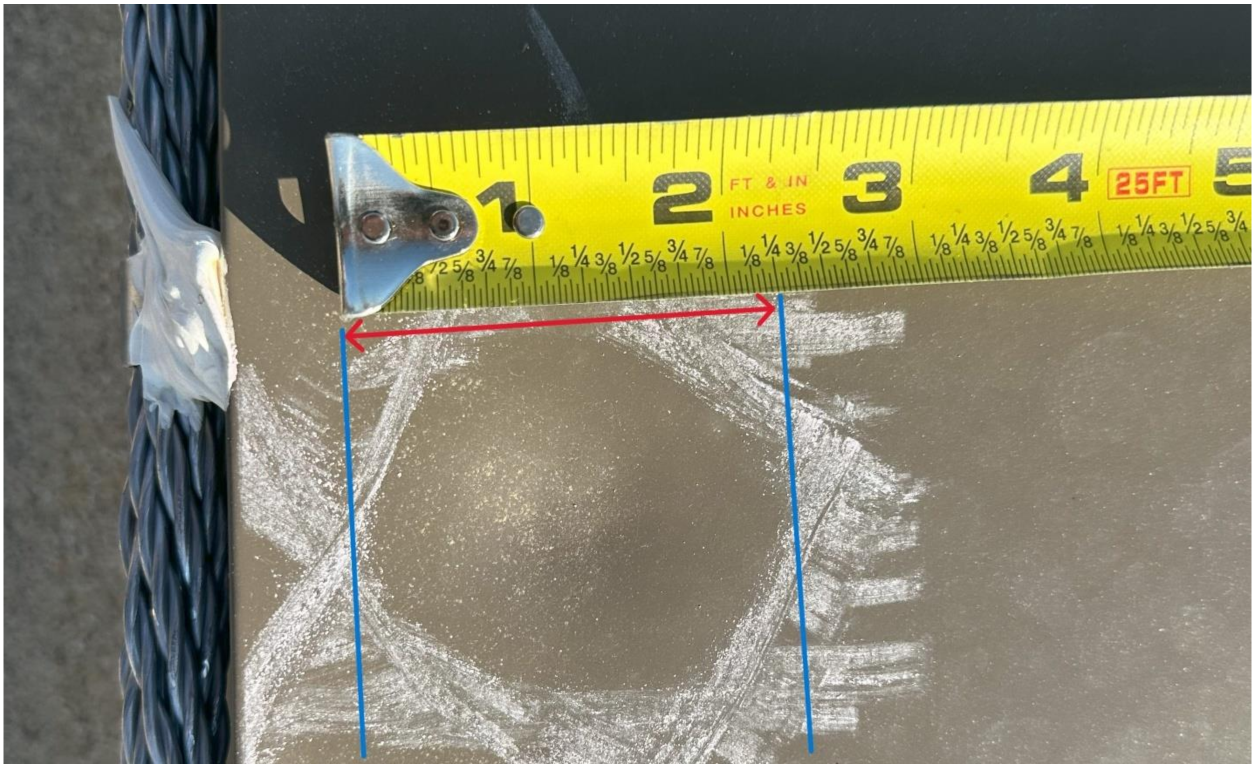

Photo 5: A close-up view of a hail indentation on metal coping indicated hail size of approximately two inches in diameter or larger.

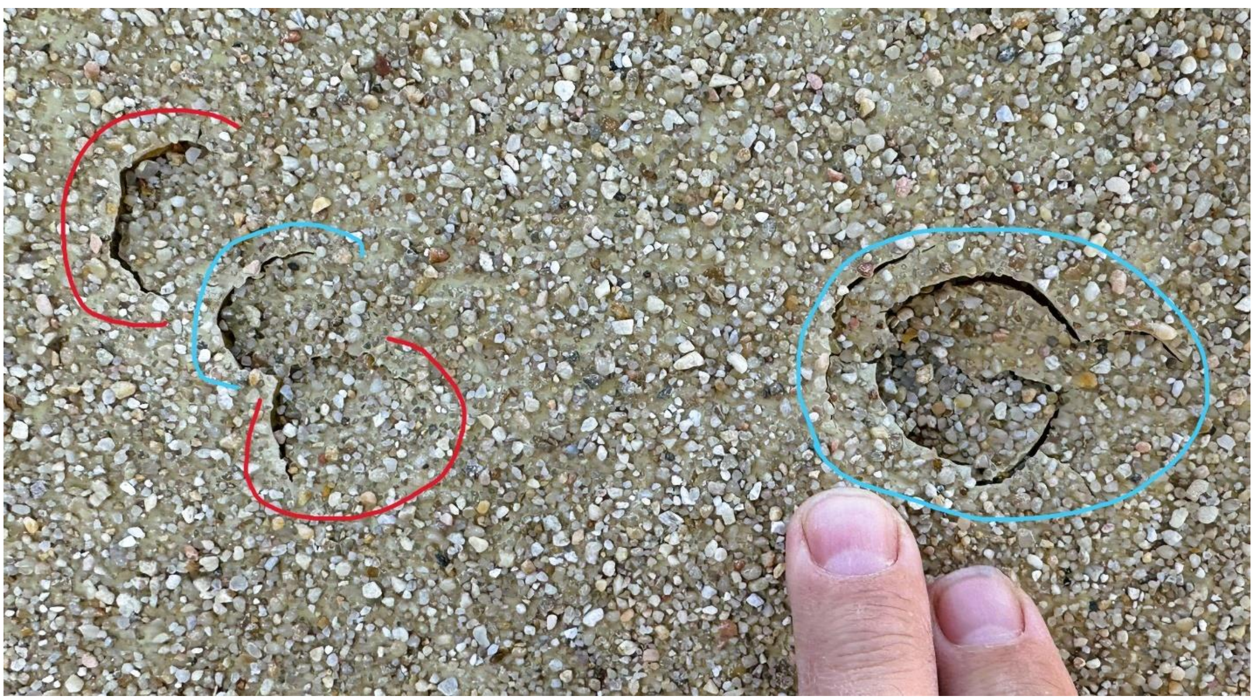
Photo 6: Multiple hail hits in close proximity may combine to create larger openings in SPF membrane.

Photo 7: Both photos on this page are close-up views of hail-caused breaches in the SPF membrane.

Photo 8

Photo 9: Both photos on this page are close-up views of hail-caused breaches in the SPF membrane.

Photo 10

ENGINEERING ACTIVITIES, BUILDING A

Photo 1: A wide-angle view from the top of the Peterson Building shows a shingle-covered roof with three intersecting wings covered with standing seam metal panels.

Photo 2: Widespread hail spatter (white blotches) were observed on the concrete walkway beneath these roofs. Spatter indicated hail sizes of 1-3/4-inches in diameter or larger.

Photo 3: Both photos on this page show copper-capped exhaust vents with numerous indentations consistent with hail. However, it was not clear that these dents were from the DOL i.e., it is possible they were from a previous hail event.

Photo 4: Chalk-marked dents indicated a combination of small and large hail.

Photo 5: Both photos on this page show aluminum exhaust vents with numerous indentations consistent with hail. However, it was not clear that these dents were from the DOL i.e., it is possible they were from a previous hail event.

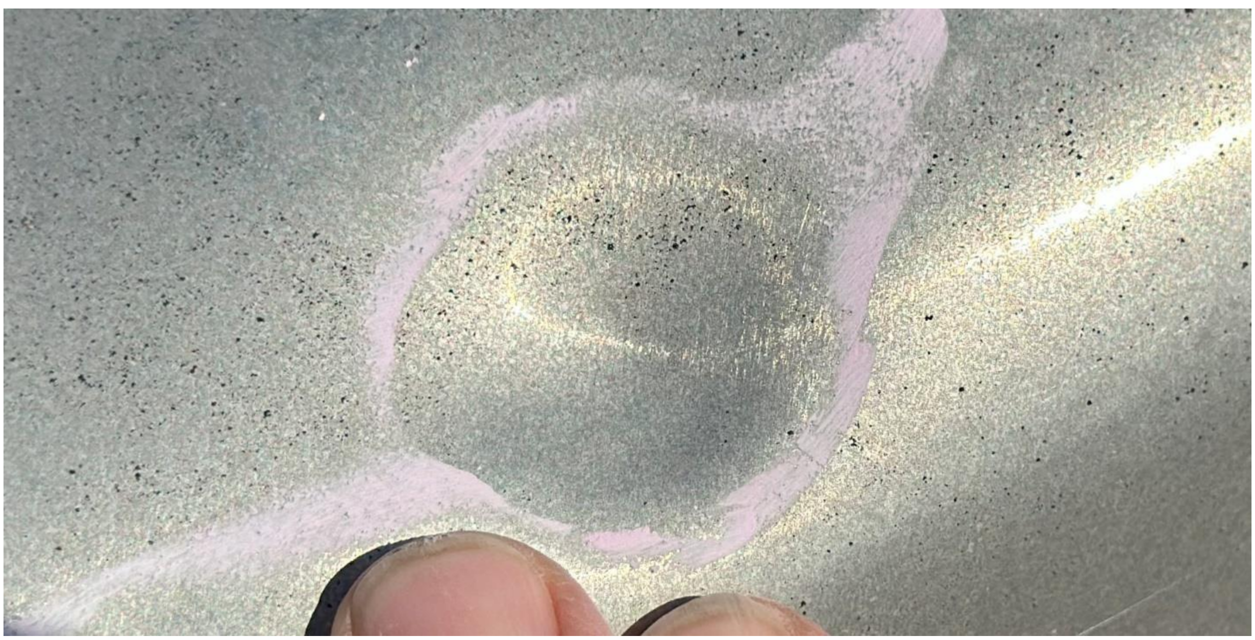

Photo 6

Photo 7: Numerous round dark spots were consistent with granule loss caused by traumatic impact from hail on the DOL. Even when hail does not cause fractures or holes in the mat, exposure of the asphalt to ultraviolet light triggers oxidation, which shortens roof service life. Some of these spots also were soft to the touch i.e., exhibited bruises.

Photo 8: Close-up views of bruises and granule loss consistent with traumatic impact from hail on the DOL.

Photo 9: A close-up view of an apparent hail hit shows what appears to be slightly oxidized asphalt and glass fiber scrim (arrows) showing through, which indicate either older damage or sharper or harder hailstones, which caused detachment of the asphalt coating.

Photo 10: Both photos on this page show more anomalies (bruises and granule loss) consistent with traumatic impact from hail on the DOL.

Photo 11

Photo 12: Both photos on this page show indentations on prefinished steel standing seam roofs consistent with traumatic impact from hail on the DOL.

Photo 13

Photo 14: A close-up view of a typical indentation consistent with hail on the DOL.

SCOATES HALL

Photo 1: Both photos on this page show wide views of the TPO-covered Scoates Hall roof. Other than spatter and dents on ancillary components, the membrane had no apparent hail damage.

Photo 2: The symmetrical pattern of round dark spots indicate the presence of fasteners and disks beneath the TPO surface. White asymmetrical splotches indicate hail spatter.


Photo 3: Both photos on this page show spatter consistent with hail on the DOL.


Photo 4: The larger spatter indicates hailstone sizes 1-3/4 to 2.0-inches in diameter.


Photo 5: Dark splotches outlined in red are hail spatter on galvanized steel duct. The shape of spatter is often a clue to not only hail size, but direction of hailfall.

Photo 6: Both photos on this page show indentations on metal duct consistent with traumatic impact from hail on the DOL.

Photo 7

Photo 8: Both photos on this page show more dents consistent with traumatic impact from hail on the DOL.

Photo 9

BLOCKER BUILDING

Photo 1: Both photos on this page show the SPF-covered Blocker Building roof.

Photo 2: While wide views may seem to show pristine surfaces, closer inspection was required to identify damage that may not have been detectable otherwise.


Photo 3: Both photos on this page show spatter consistent with traumatic impact from hail on the DOL. This photo shows the granule-surfaced SPF system.

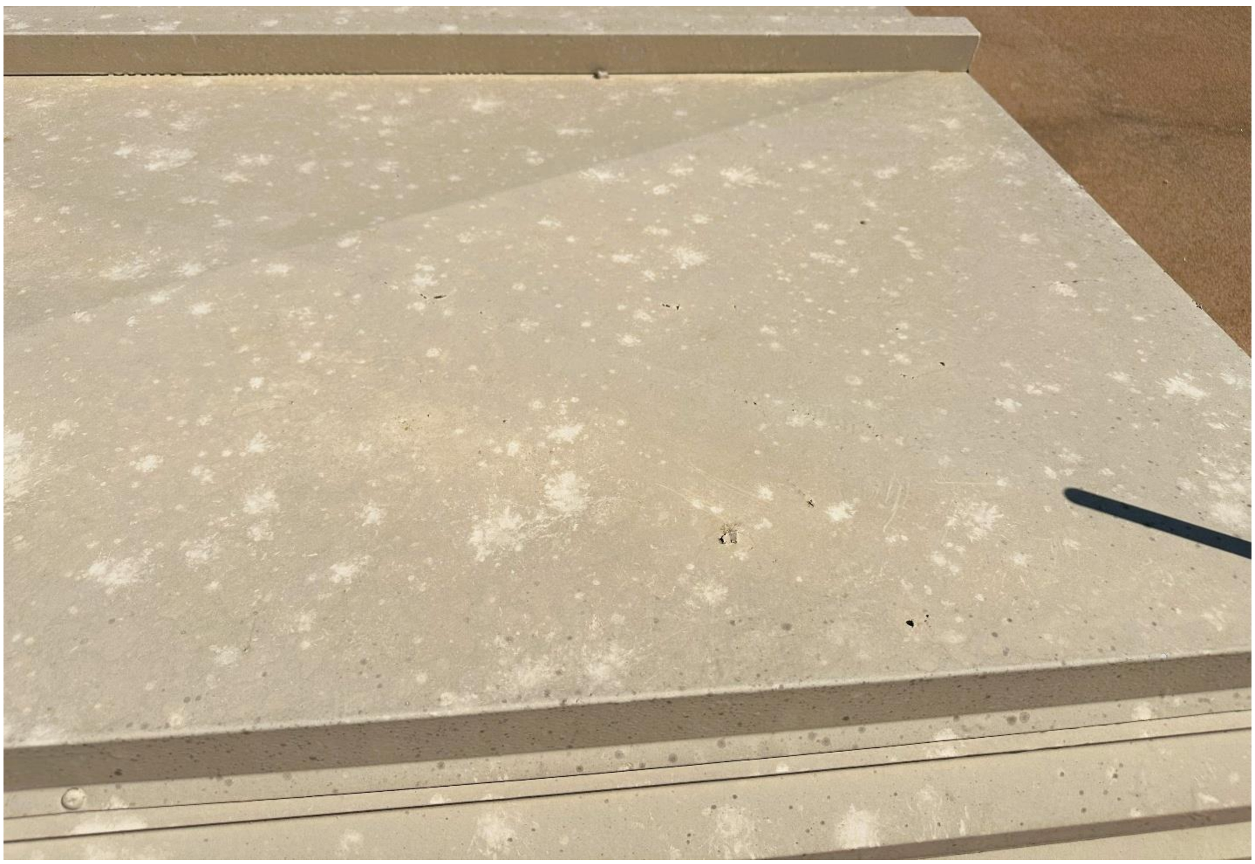
Photo 4: This spatter (light-colored spots) was on a metal cap over a curb.

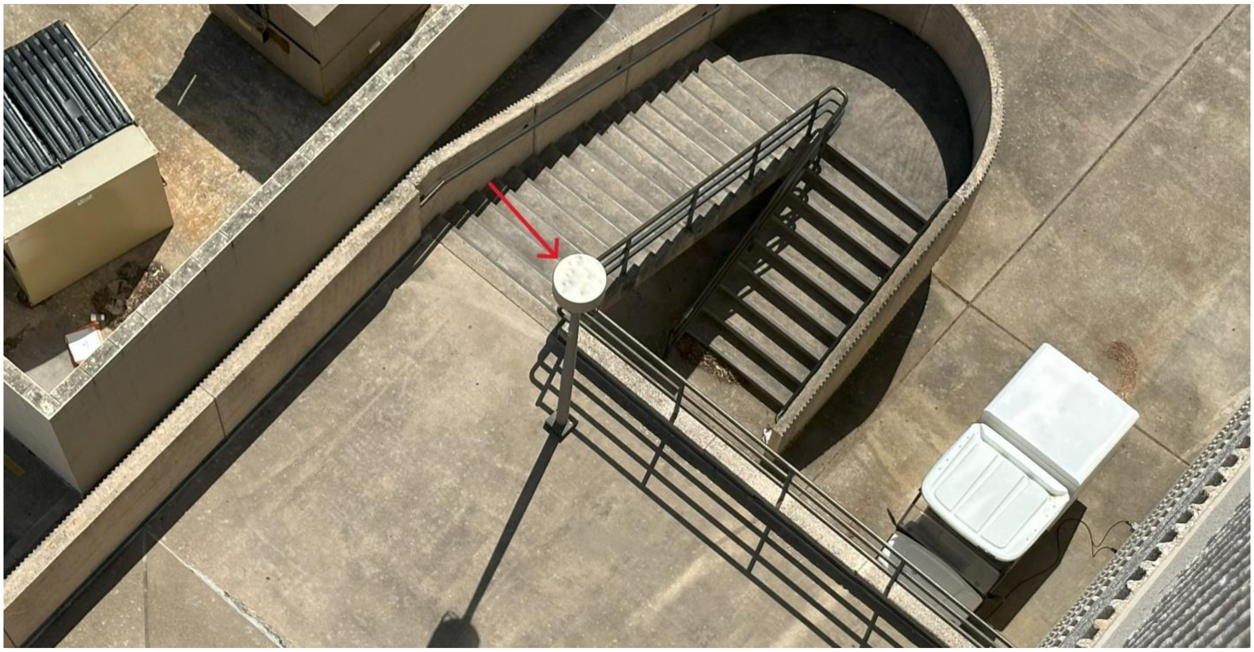

Photo 5: Both photos on this page show the top of a round light fixture with dents consistent with traumatic impact from hail on the DOL.

Photo 6: Note that dents were both large and numerous i.e., multiple hits per square foot. Some hailstorms exhibit hail just as large or larger but are spaced farther apart.

Photo 7: Both photos on this page show fractured SPF assembly consistent with traumatic impact from hail on the DOL.

Photo 8: The breached SPF membrane on the Blocker Building did not appear to be as severe as on others inspected.


Photo 9: Another large fracture through the SPF.

GENERAL SERVICES COMPLEX, BUILDING 1800

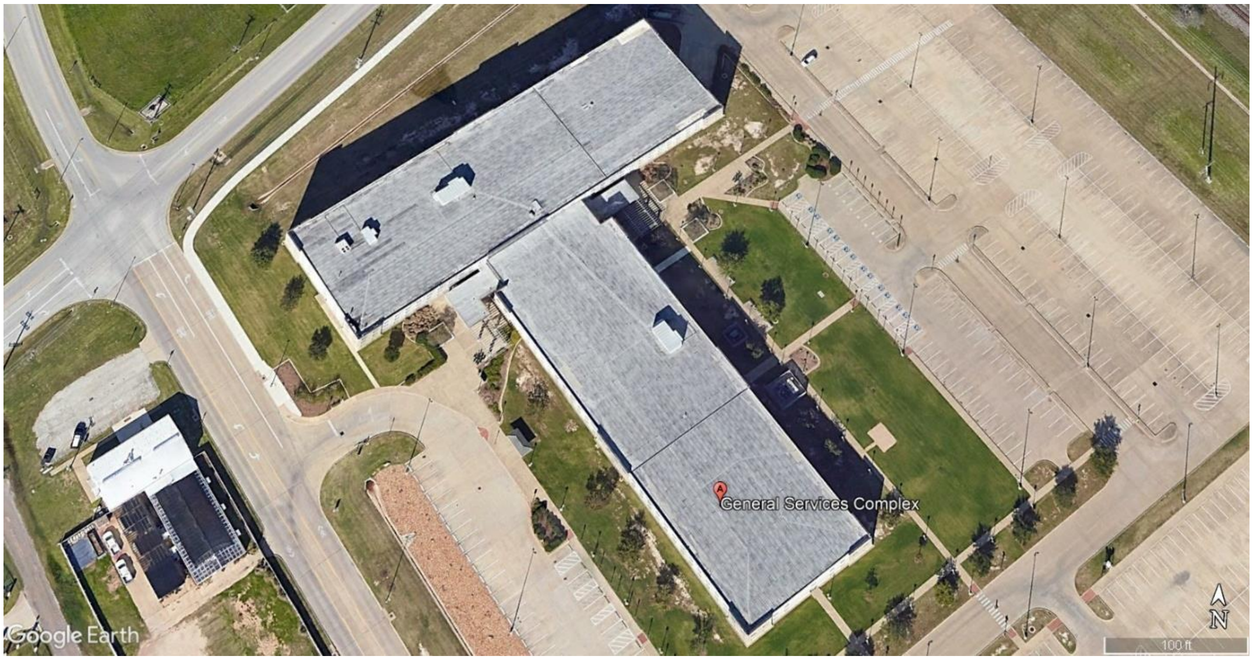

Photo 1: A Google Earth aerial view (north at top) shows a T-shaped building covered with a modified bituminous (MB) roof system.

Photo 2: A rooftop view of the juncture of the lower and upper levels.

Photo 3: Both photos on this page show wide angle views of the MB-covered lower roof level from its southern corner. The darkened areas indicate age-related granule loss.

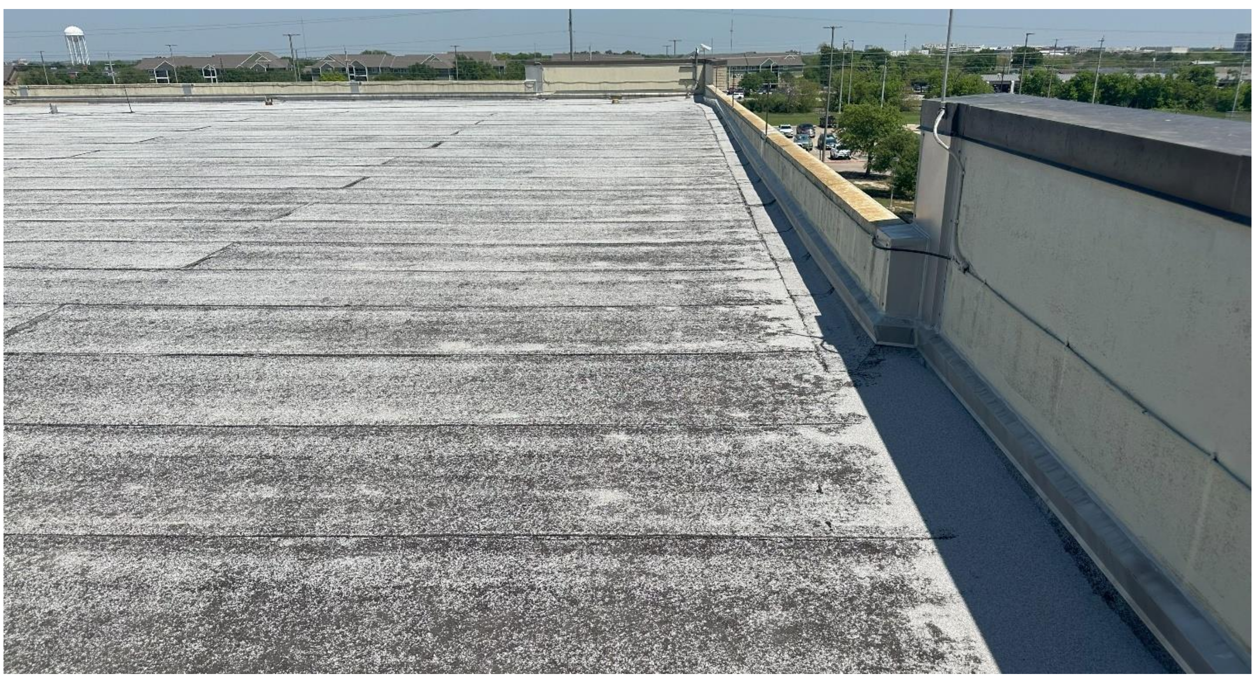

Photo 4

Photo 5: Both photos on this page show hail-damaged metal coping consistent with storm conditions on the DOL.

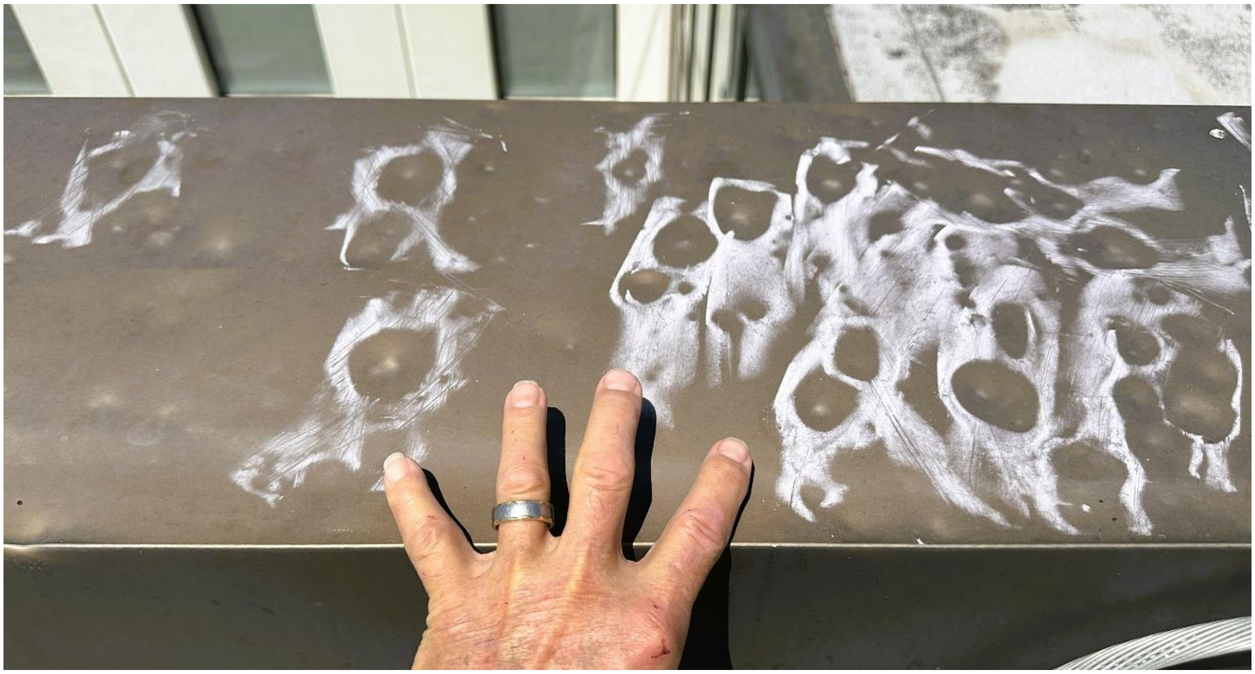

Photo 6

Photo 7: Both photos on this page show hail-damaged metal counterflashing consistent with storm conditions on the DOL. However, absent evidence to the contrary, many of these anomalies could be due to previous storms.

Photo 8

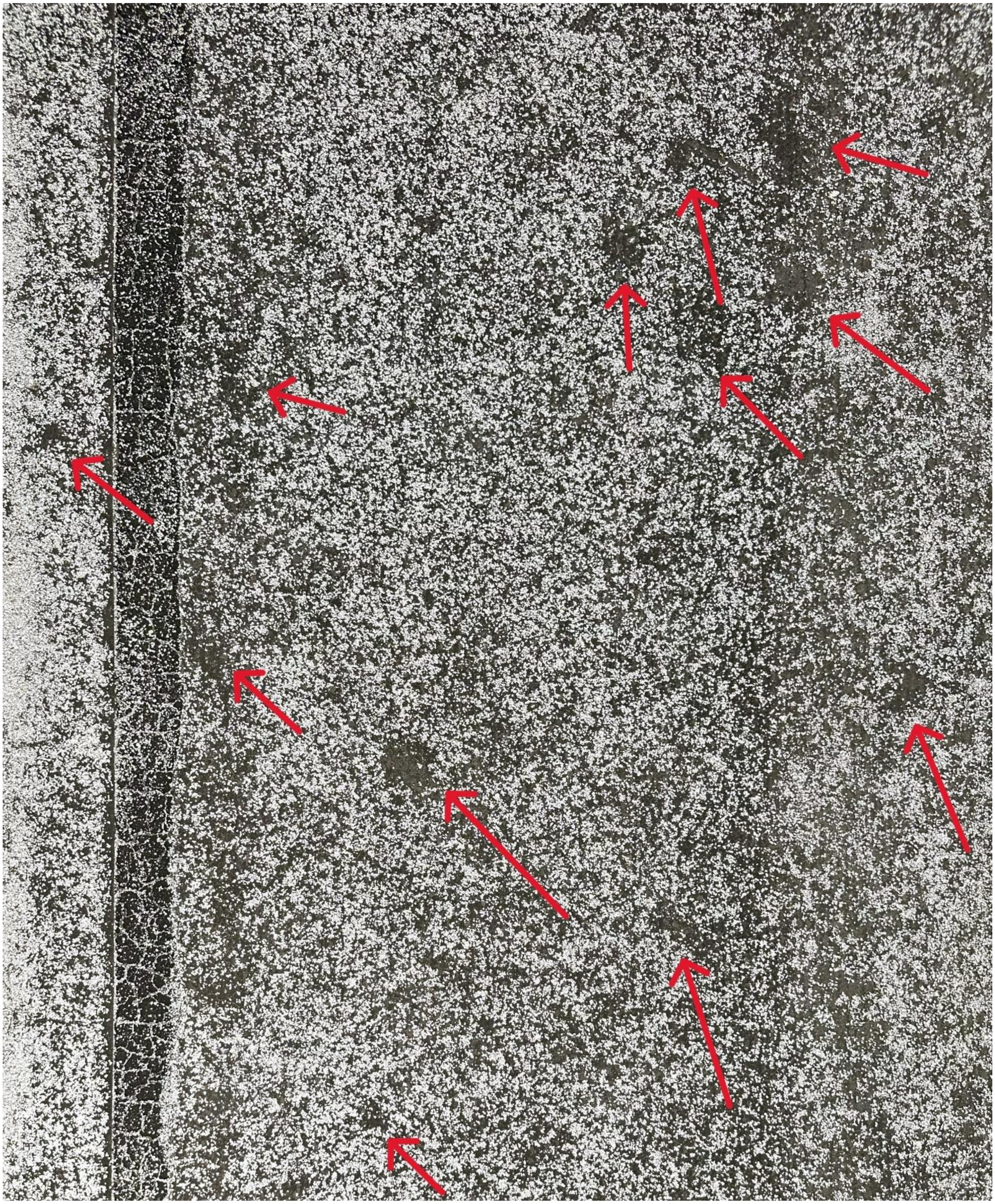

Photo 9: The hot-mopped MB membrane exhibited fairly consistent granule loss that appeared age-related. But prominent dark blotches (highlighted by arrows) are more likely due to traumatic impact from hail.

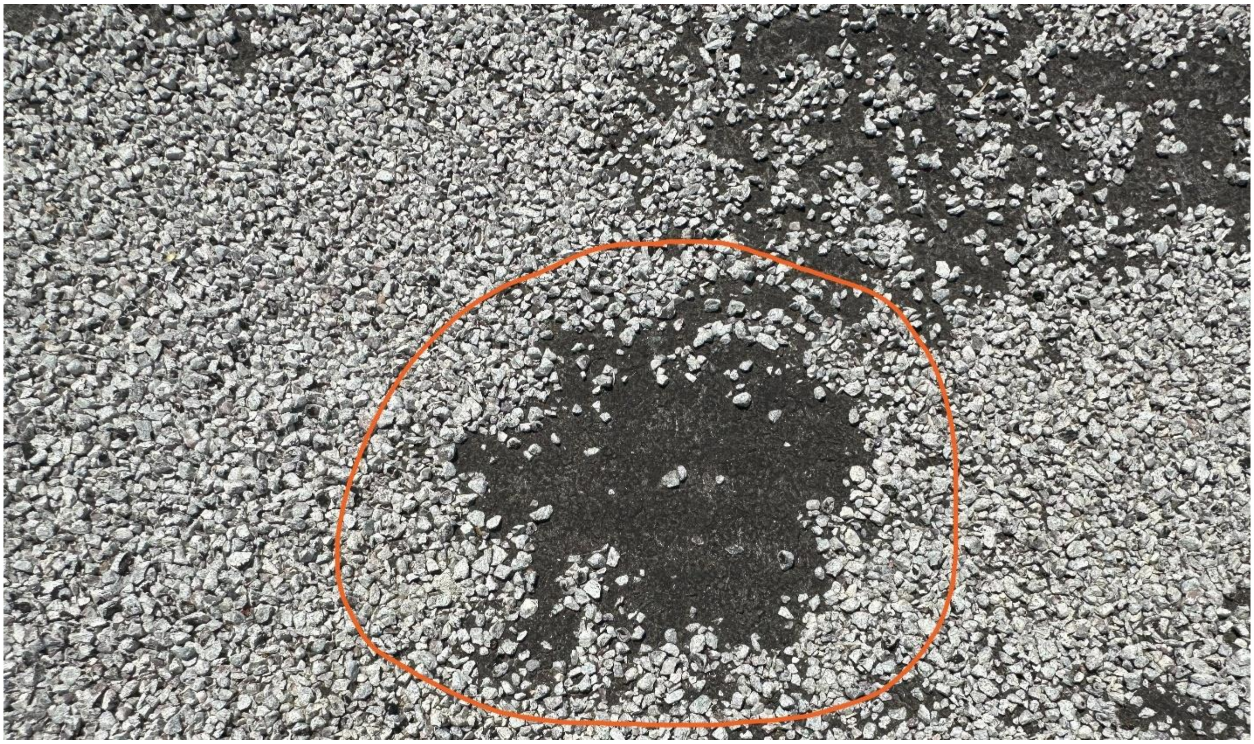

Photo 10: Both photos on this page show conspicuous dark blemishes where granules were detached in relatively large spots. This is consistent with storm conditions on the DOL.

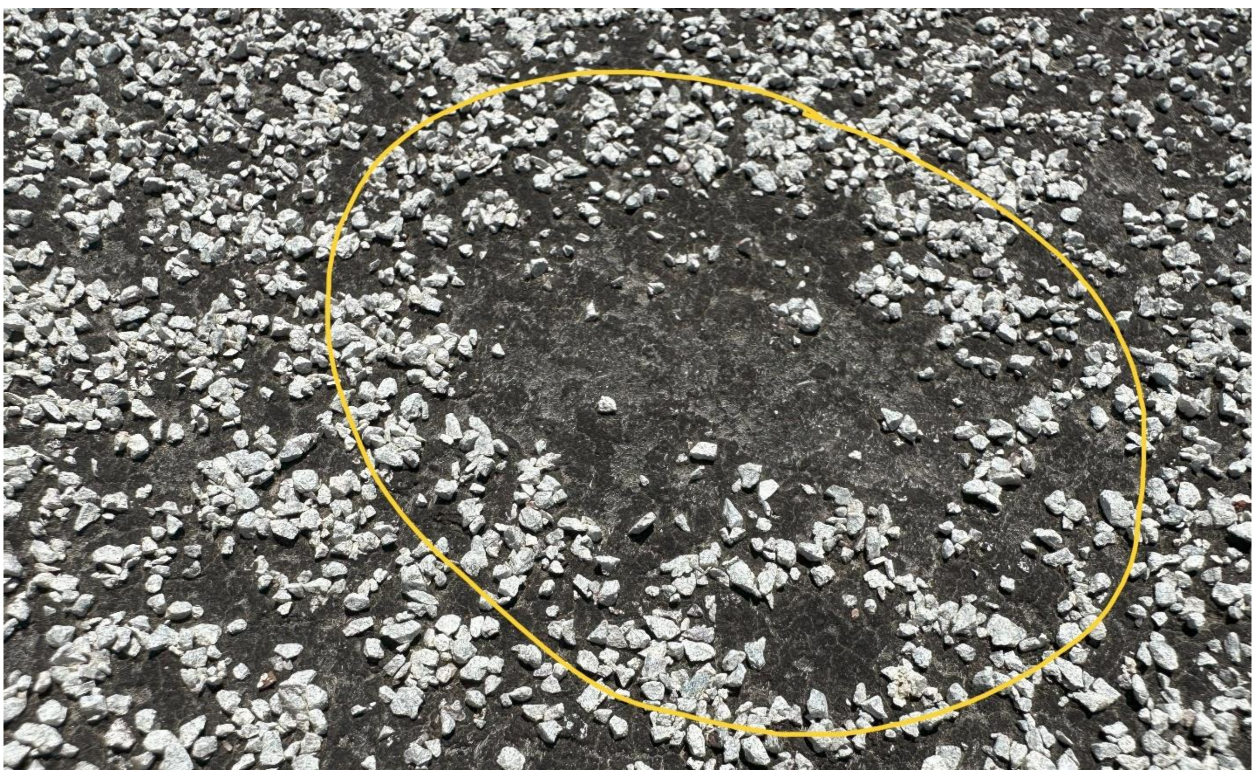

Photo 11

Photo 1: Both photos on this page show wide angle-views of Clements Residence Hall from its southern corner.

Photo 2: The SPF-covered roof appeared to be in good overall condition, despite exposure to large hail on the DOL.

Photo 3: Light-colored rectangular spots (blue arrows) were SPF repairs applied prior to the DOL. These SPF repairs were reportedly done without polyurea coating.

Photo 4: Another view of some pre-DOL patches (blue arrows) being inspected for storm damage.

Photo 5: Both photos on this page show the same pre-DOL patch with damage that occurred on the DOL.

Photo 6: This hole was approximately 1.5 inches in diameter, consistent with storm conditions on the DOL. The patch was coated only with granules and silicone, but without polyurea, like the rest of the roof. This left them more vulnerable to impact damage than the adjacent Standard TAMU SPF System, which incorporated both silicone and polyurea coatings beneath the granules. This was a significant side-by-side comparison of the two similar, but not equal, systems.

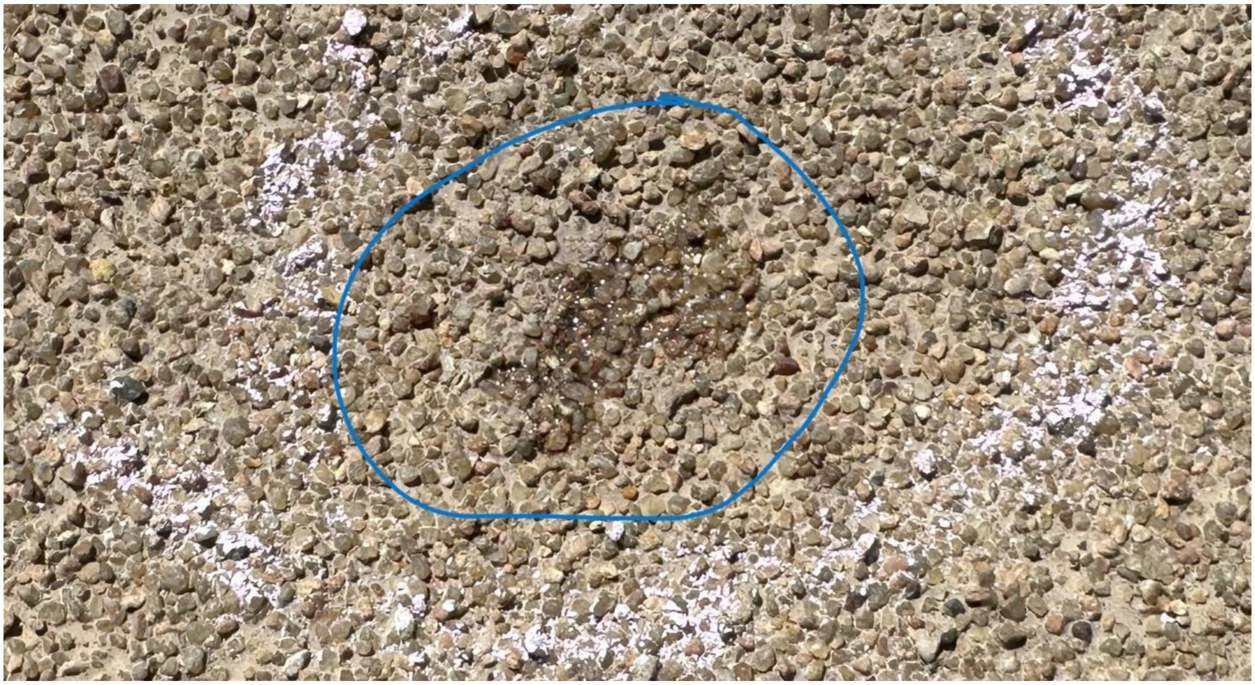

Photo 7: Both photos on this page show openings on pre-DOL patches consistent with hail on the DOL. Several openings like this were observed, all on the patches, not in STSS-covered areas.

Photo 8: Water entrapped beneath the surface was expelled when hand pressure was applied next to some fractures.

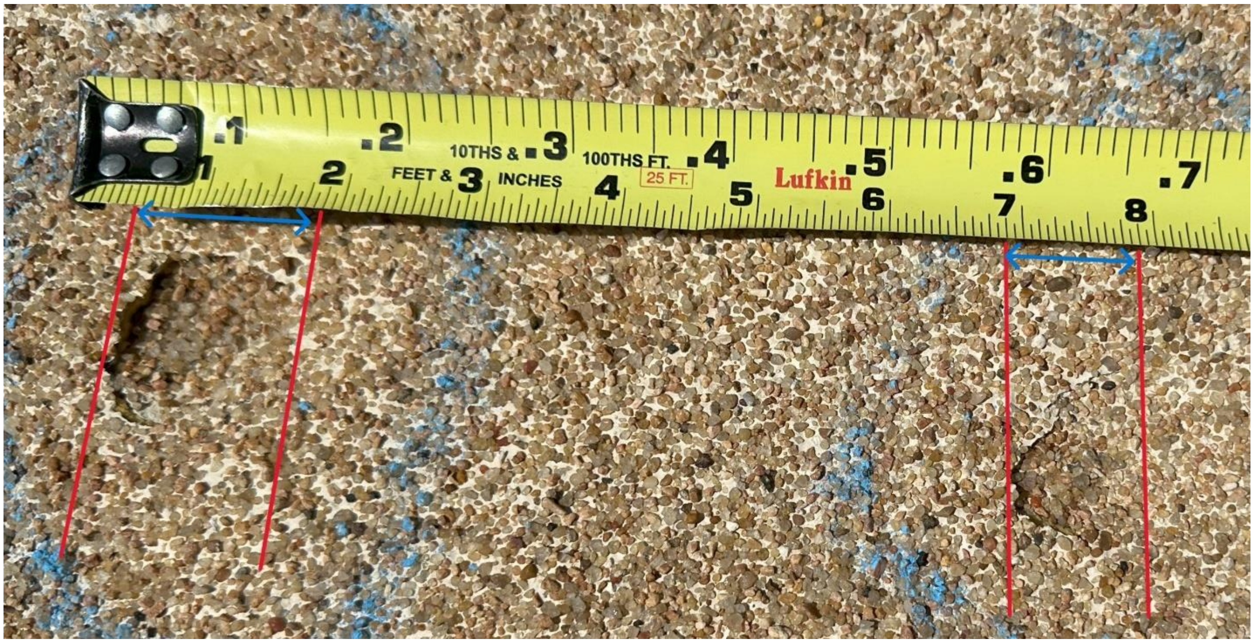

Photo 9: Two holes on a pre-DOL patch, indicating hailstone sizes 1.5-inches in diameter or larger.

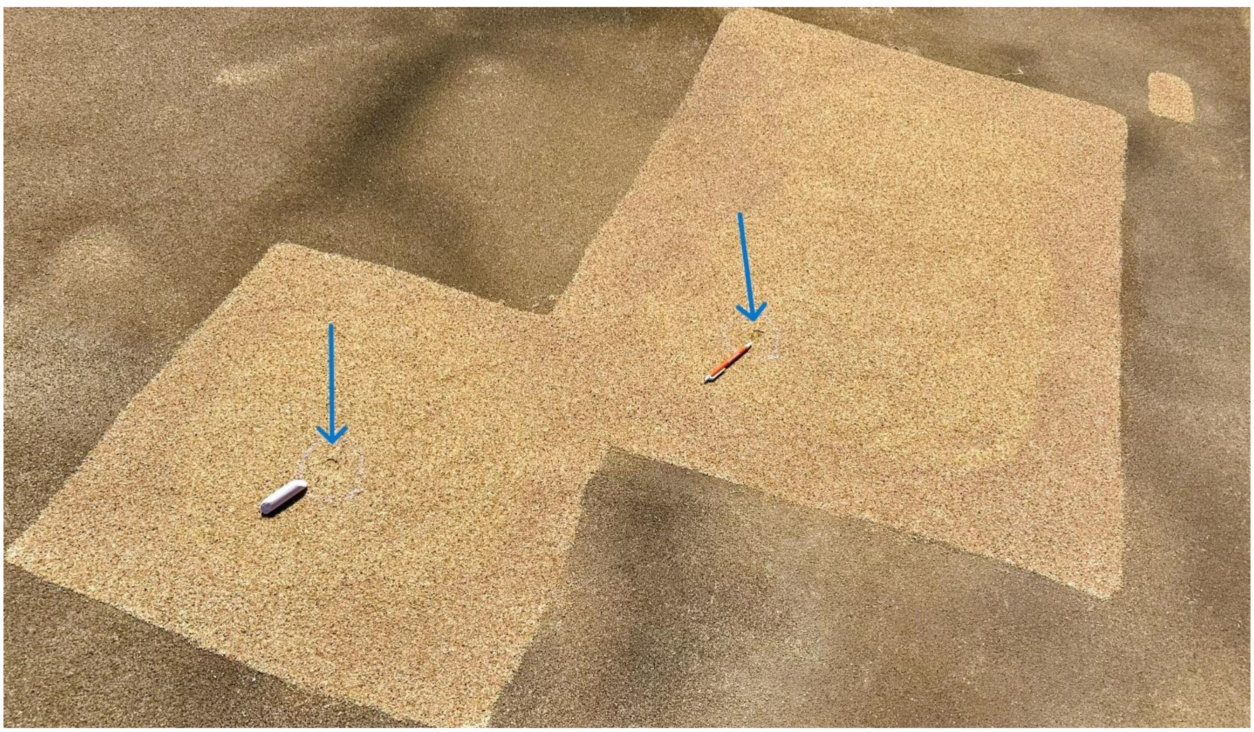
Photo 10: Two more holes in a pre-DOL patch. See the following two photos for close-up views.

Photo 11: Another close-up view of one of the holes shown in Photo 10. This is consistent with hail on the DOL.

Photo 12: A close-up view of one of the holes shown in Photo 10. This is consistent with hail on the DOL. Water was expelled when subjected to hand pressure around the opening.

End of Photos

REFERENCES

[1] **IIBHS –** Insurance Institute for Business and Home Safety – Hail Causes the Most Storm Damage Costs Across North America
https://eos.org/articles/hail-causes-the-most-storm-damage-costs-across-north-america

[2] **The Weather Company –** Severe hail & property damage – one-inch hail is severe –
https://weather.com/storms/severe/news/how-hail-forms

[3] **StormerSite -** http://www.stormersite.com/hail-history-reports#

[4] **Coyne -** *Wind Effects on Hail Velocity and Impact Energy,* by: Jeff Coyne, P.E.
https://donan-profiles.hatfield.marketing/article/wind-effects-on-hail-velocity-and-impact-energy/

[5] **Heumsfield, et al** – Terminal Velocities – https://doi.org/10.1175/JAS-D-18-0035.1
A Comprehensive Observational Study of Graupel and Hail Terminal Velocity, Mass Flux, and Kinetic Energy in: *Journal of the Atmospheric Sciences Volume 75 Issue 11 (2018)*

[6] **TWN -** The Weather Network - https://www.theweathernetwork.com/ca

[7] **KSAT** – Storm coverage from KSAT
https://www.ksat.com/weather/2021/05/04/see-pictures-of-hail-coming-down-across-the-san-antonio-area/

[8] **SWDI** – From the National Oceanic and Atmospheric Administration (NOAA), the Storm Severe Weather Data Inventory (SWDI) provides graphical storm data.
https://www.ncei.noaa.gov/maps/swdi/

RICOWI INSPECTORS

Phil S. Mayfield

RICOWI

- Storm Investigation Program Coordinator
- Former Storm Investigation Program Chair
- Education Committee Chair
- RICOWI storm damage investigator since 2005

PROFESSIONAL

- Principal at Mayfield Building Envelope Consultants since 1986
- Present/Past associations:
  IIBEC (Roof Consultants Institute)
  Construction Specifications Institute (CDT, Fort Worth Chapter President)
- Garland Architectural Services – roof consultant
- Sealant, Waterproofing, Restoration Institute – member
- The Garland Company – technical consultant
- Tremco Roofing & Building Maintenance – technical adviser

EXPERIENCE

In addition to design and specification assistance to architects and other clients, Mr. Mayfield has worked for manufacturers of building envelope systems, performed clinics for installers, attended clinics by manufacturers, monitored contractors' work, and performed thousands of inspections of roofs of all types, as well as exterior walls and waterproofing components. Ongoing work includes expert witness and appraiser/umpire resolution of storm damage claims.

For approximately forty years Mr. Mayfield has investigated and analyzed roof issues related to manufacturing defects, roof design, workmanship, maintenance, and weather-related damage.

Eric K. Olson

RICOWI

- Member, Storm damage investigator
- Joined 2024

PROFESSIONAL

- Principal, Simpson Gumpertz & Heger, Inc., Houston, TX
- Present/Past associations:
  ASTM D08, Co-Chair of D08.20 Roofing Membrane Systems
- Professional Engineer, licensed in 21 states and DC.
- University of New Hampshire, MSCE (1996), BSCE (1994)

EXPERIENCE

Eric Olson is a member of SGH's Building Enclosure Consulting group in Houston, Texas. He specializes in evaluating and investigating building enclosure systems, including windows and curtain walls, cladding and veneer systems, roofing, plaza waterproofing, and below-grade waterproofing. His investigation experience includes hurricane and storm-related damage, design and construction defect claims, surety claims, litigation related to building enclosure systems, and enclosure system condition assessments for due diligence purposes or establishing maintenance and replacement needs. Eric also leads rehabilitation design projects for enclosure systems and performs design consulting for enclosures for new and existing buildings. Eric is past co-chair of ASTM D08.20 – Roofing Membrane systems, and joined RICOWI in 2024 to bring his forensic investigation experience to the Storm Investigation Program.