



High Concentration of Small Hailstones

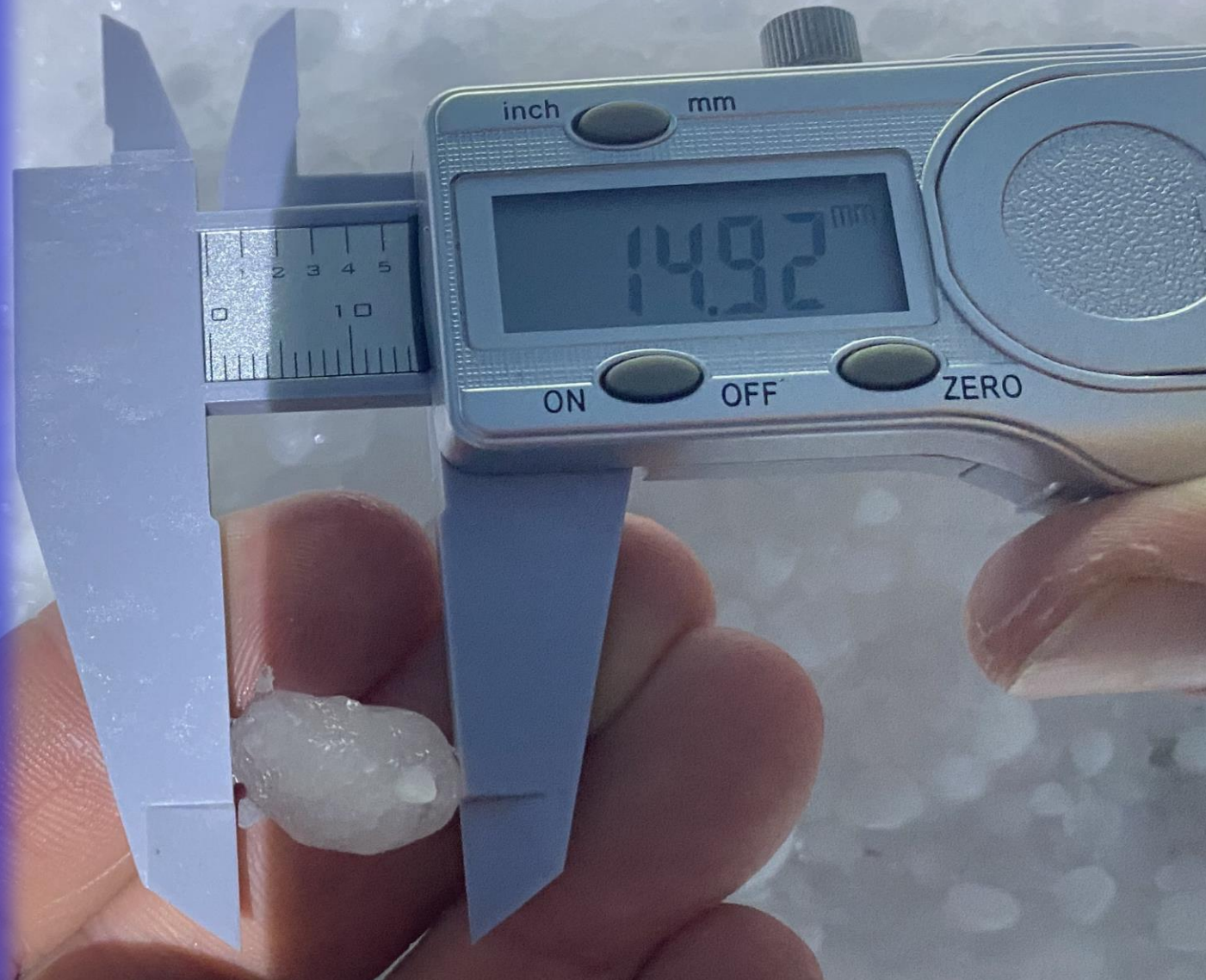
Brenna Meisenzahl

Research Project Scientist

Insurance Institute for Business & Home Safety



- ❖ Shorten lifespan
- ❖ More susceptible to damage
- ❖ Visual evidence likely lead to claims



Identifying Damage

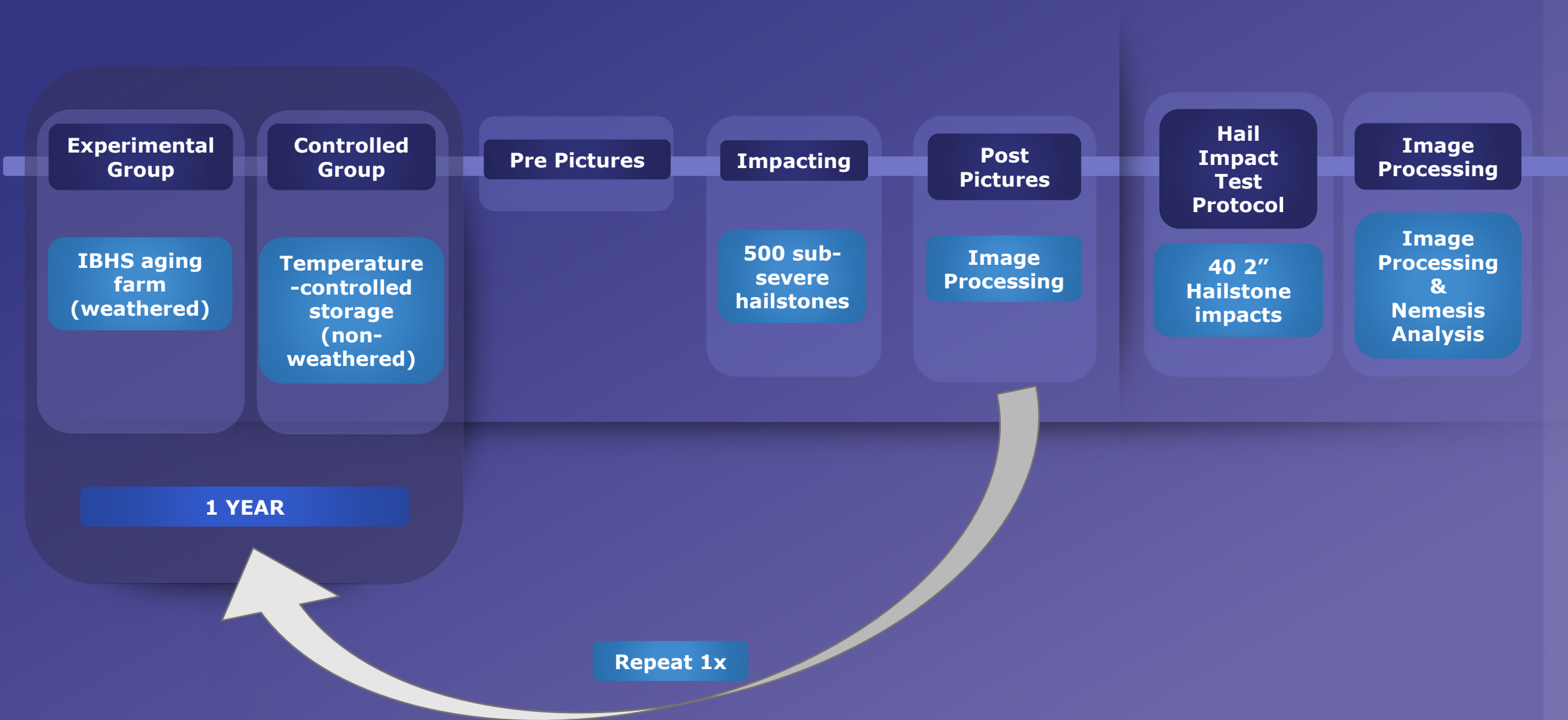


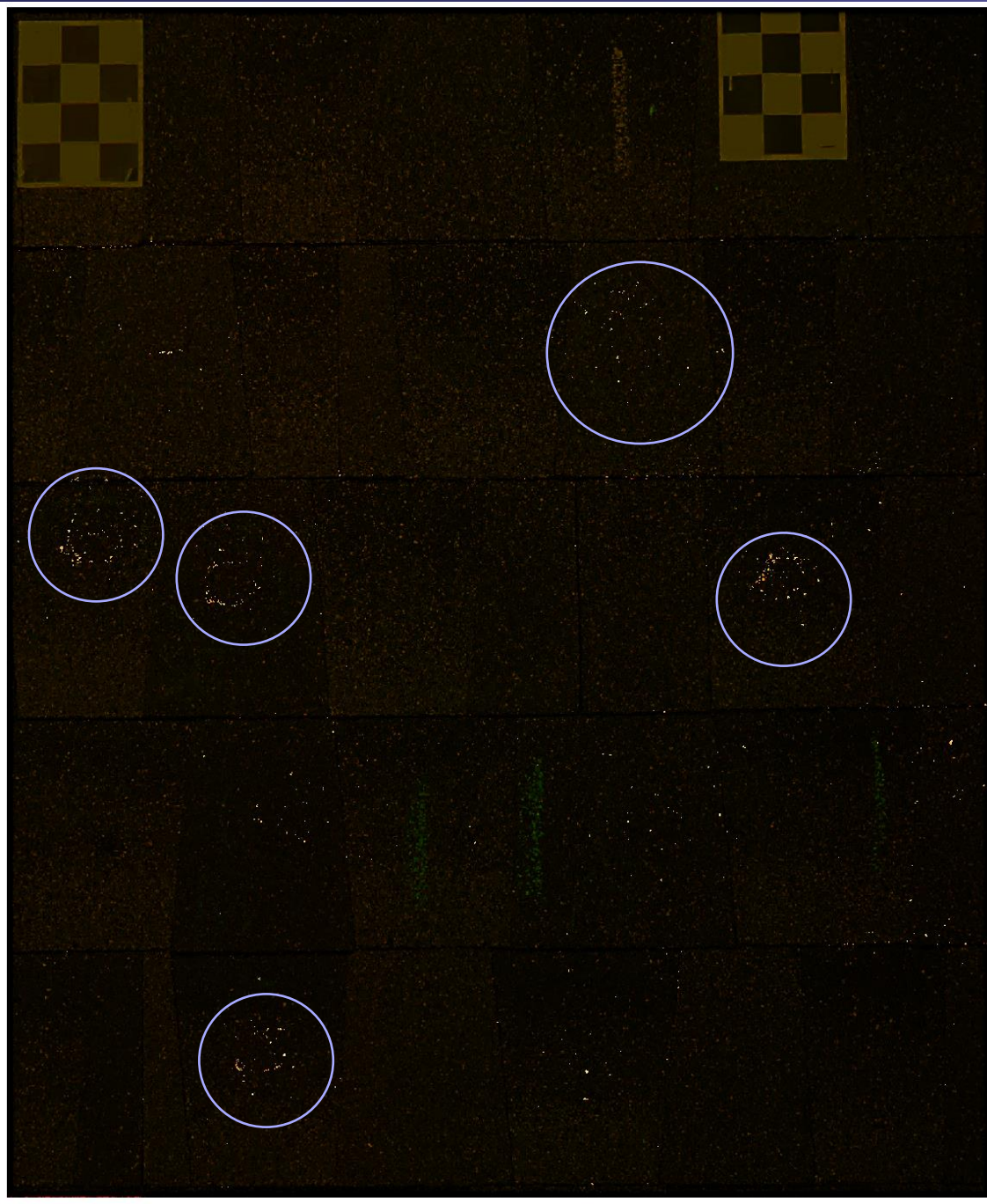
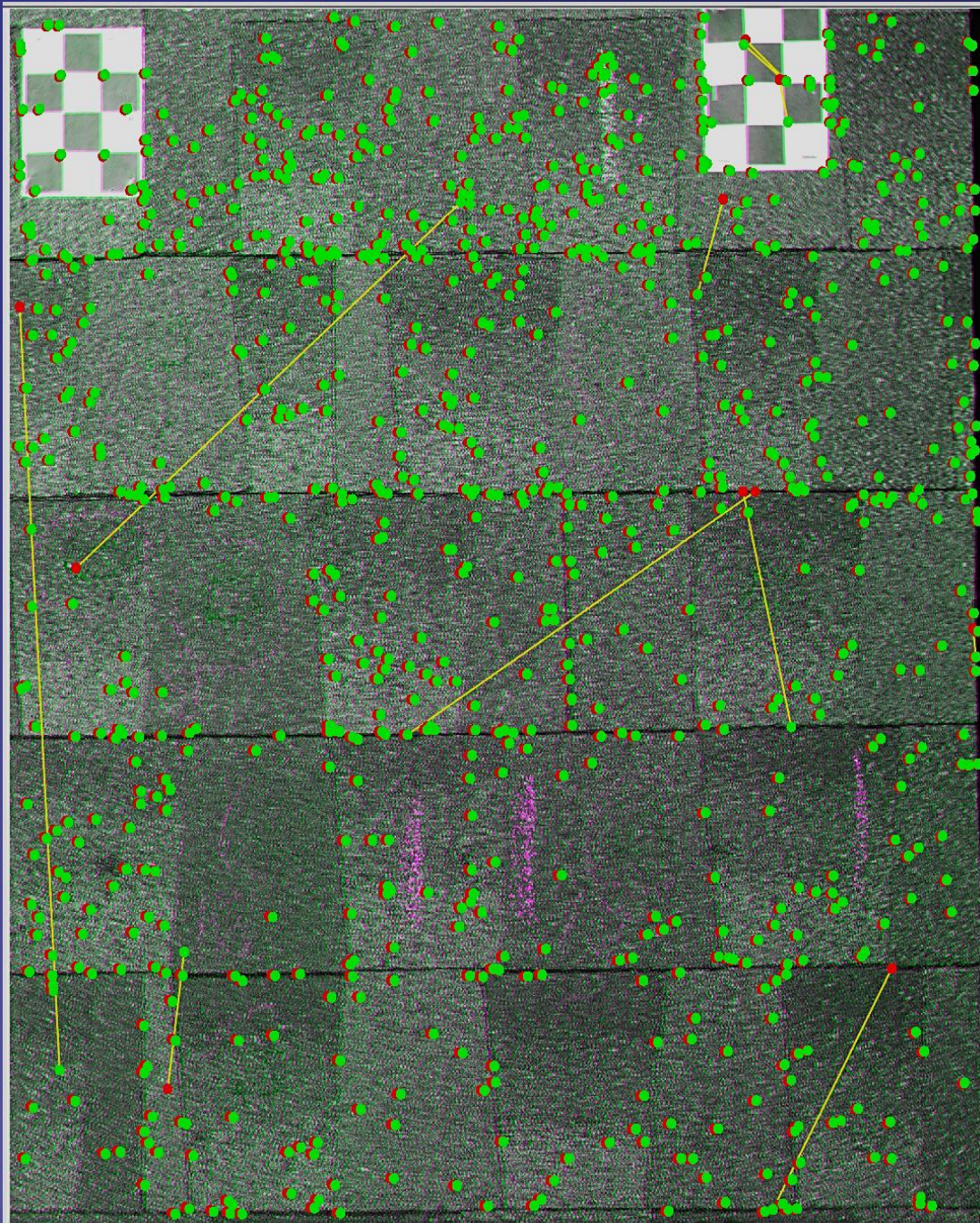
MACHINE VISION



**QUANTITATIVE
DATA ANALYSIS**

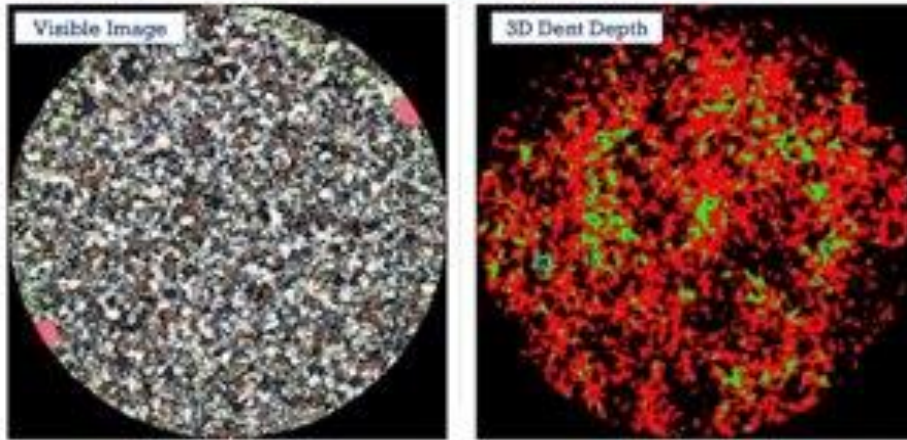
TESTING PLAN



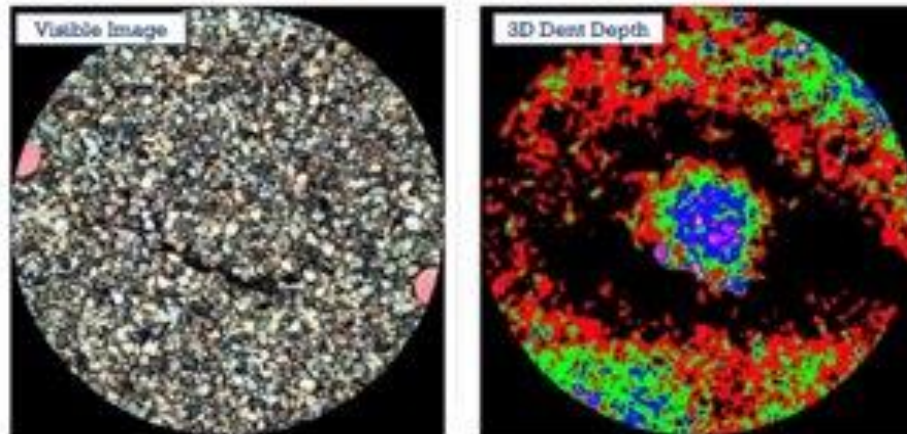


Nemesis Analysis

2-Inch Impact with Little Damage



2-Inch Impact with Significant Damage

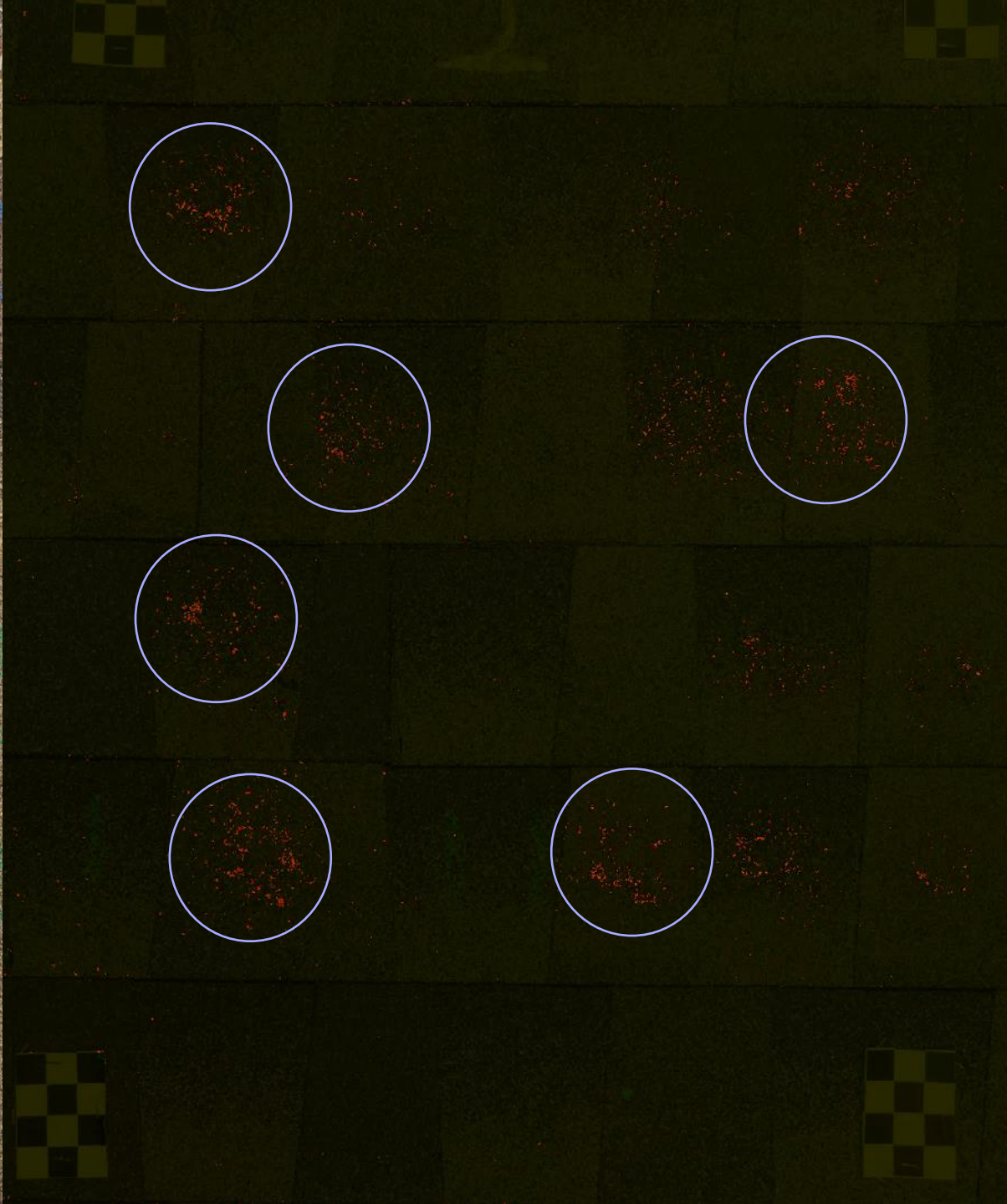


❖ Depth of dents

❖ Height of ridges

❖ Tearing



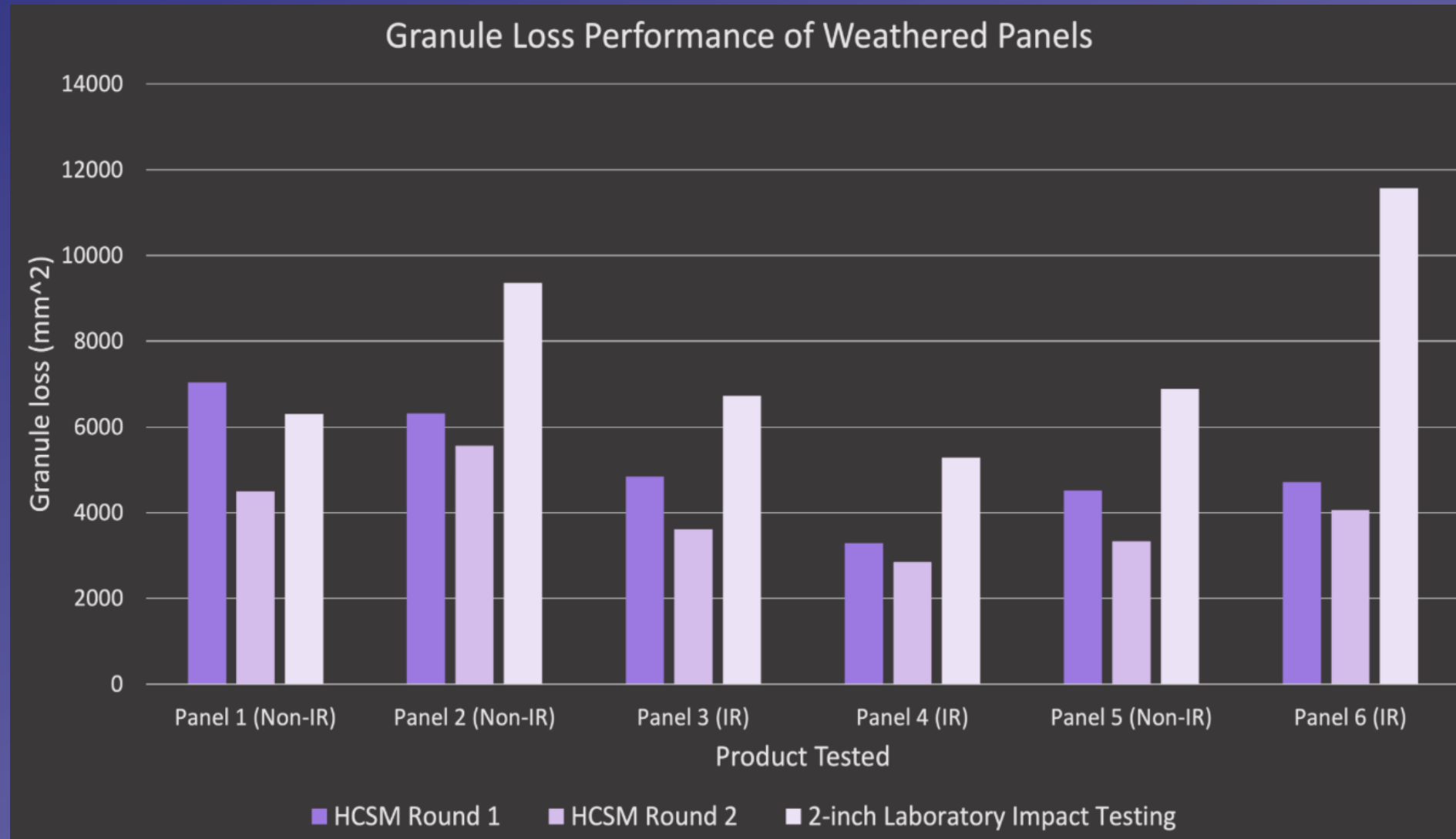




Key Findings

Granule Loss Results on Experimental Group

- ❖ Damage is not limited to conventional products, it's seen through the asphalt shingle spectrum
 - ❖ IR and Non-IR product showed highest amount of granule loss



Small Hail and Natural Exposure Makes Roofs Susceptible

| | New Panels (Baseline) | Stored Panels (Control) | Naturally-weathered Panels |
|--|--------------------------|----------------------------|-------------------------------|
| Round 1: Small Hail—.75-1" Average granule loss per impact after 1 year. (500 impacts) | | 9.5 mm ² | 10.2 mm ² |
| Round 2: Small Hail—.75-1" Average granule loss per impact after 1 more year. (500 impacts) | | 5.7 mm ² | 8.0 mm ² |
| Round 3: Large Hail, 2" Average granule loss per impact. (40 stones) | 20.0mm ² | 57.2 mm ² | 192.2 mm ² |
| Damage Multiplier | 1X | 2.9X | 9.6X |

Takeaway: Round 3 large hail impacts deal 2.9X more damage when preceded by small hail. Large hail can deal 9.6X more damage after both natural weathering and small hail exposure.

Key Takeaways

Sub-severe hailstones cause nearly 30% of the granule loss from a 2-inch stone.

Asphalt shingles are 10x more susceptible to damage after weathering & small hail impacts

Asphalt exposed to UV will become more brittle!

Small hail events can...

- ❖ Reduce a roof's lifespan
- ❖ Make it more susceptible to future hail events
- ❖ Exacerbate the natural aging of asphalt shingles







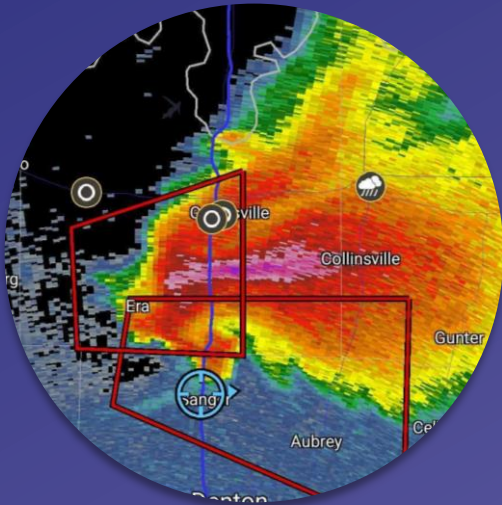
Damage Potential of Slushy Hailstones

Jake Sorber

Research Project Scientist

Insurance Institute for Business & Home Safety

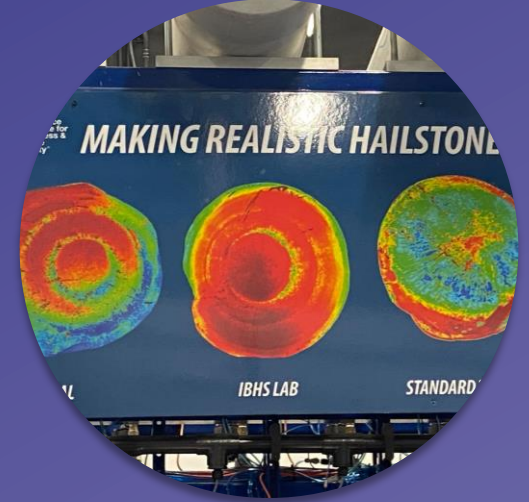
Identify



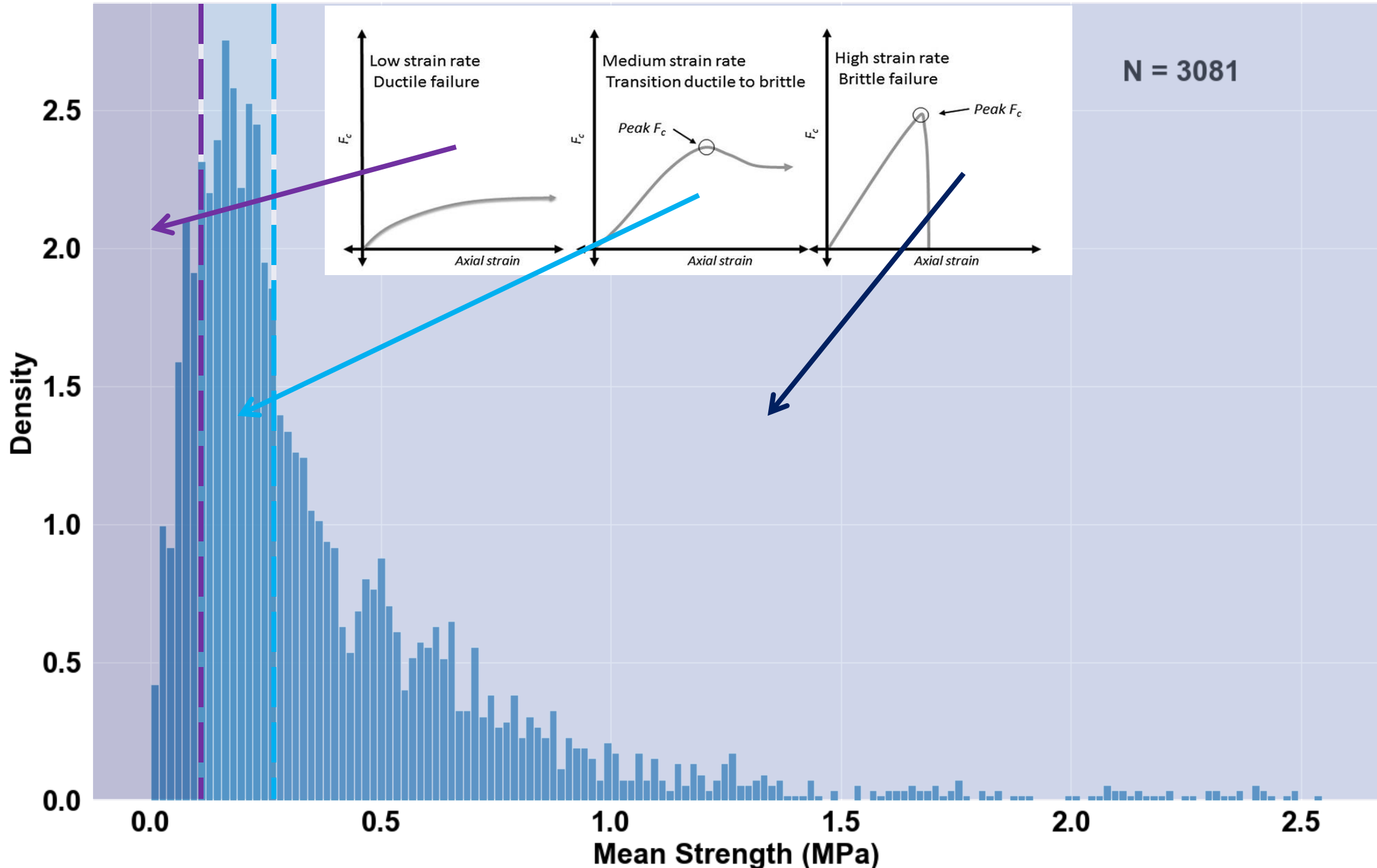
Document



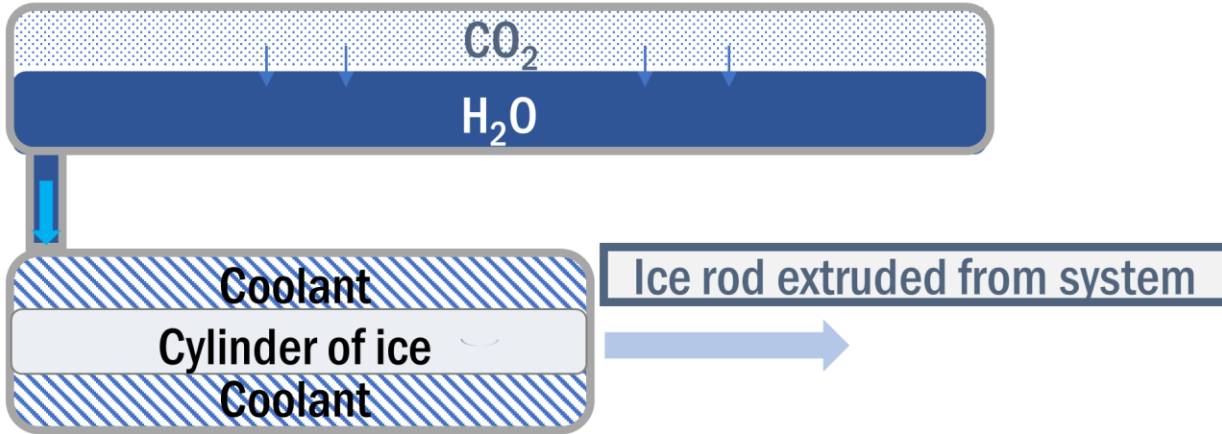
Apply



Compressive Strengths of Natural Hailstones



Idealized Process Diagram



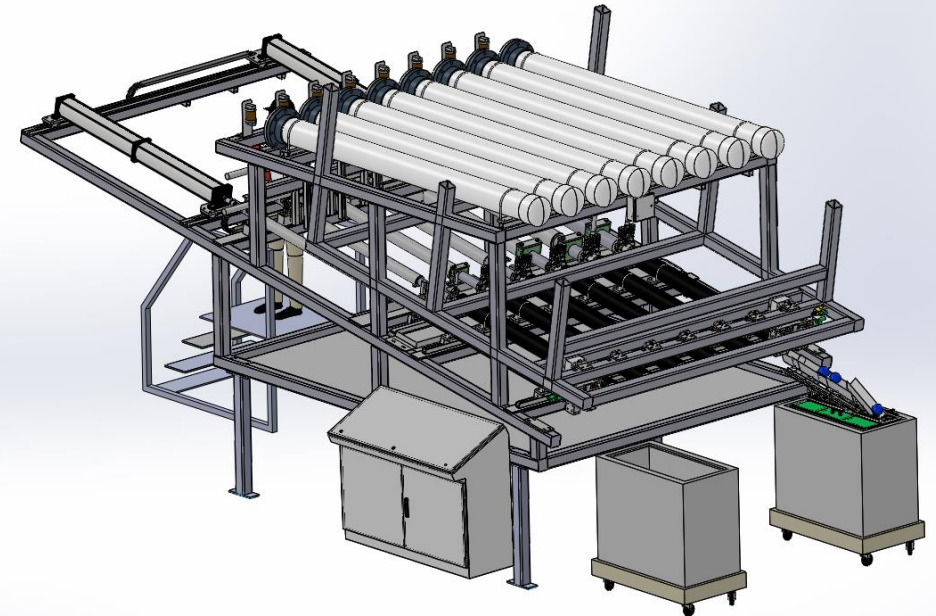
Liquid chilled to target temperature for ice production
Control: $+5^\circ$ to $+20^\circ$ F

Controls:

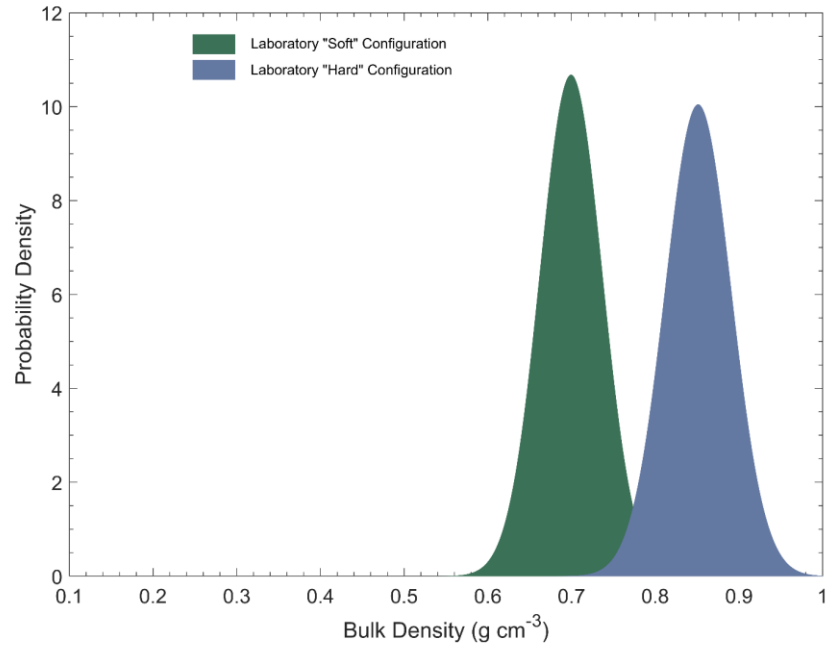
- Gas diffusion pressure & duration
- Freeze temperature & duration
- Thaw temperature & time

Capacity:

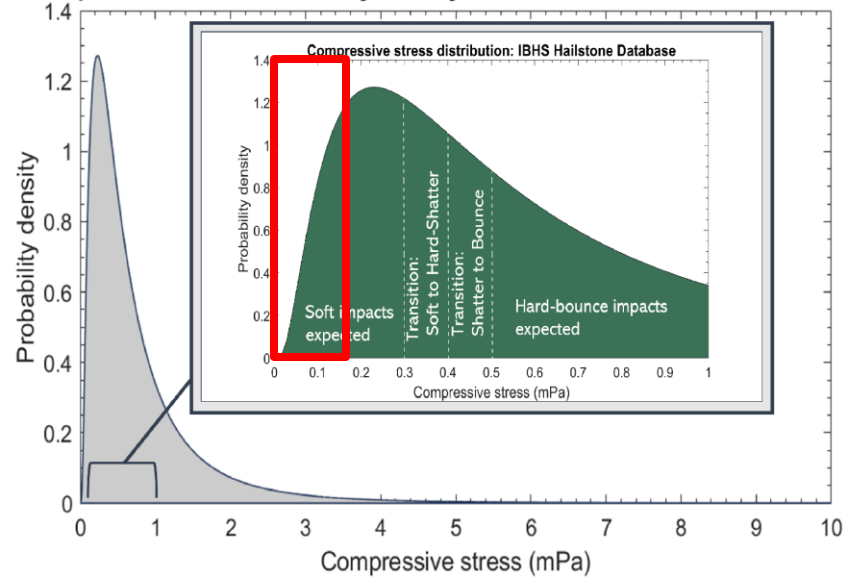
- Sizes: 0.75-3.5 in. (0.25 in. intervals)
- 300-500 stones per 8 hrs
- 2 lines run simultaneously



Laboratory Manufactured Hailstones Bulk Density Probability Density Functions



Compressive Stress Probability Density Distribution: IBHS Hailstone Database



A. Impact mode: Soft



B. Impact mode: Hard shatter



C. Impact mode: Hard bounce



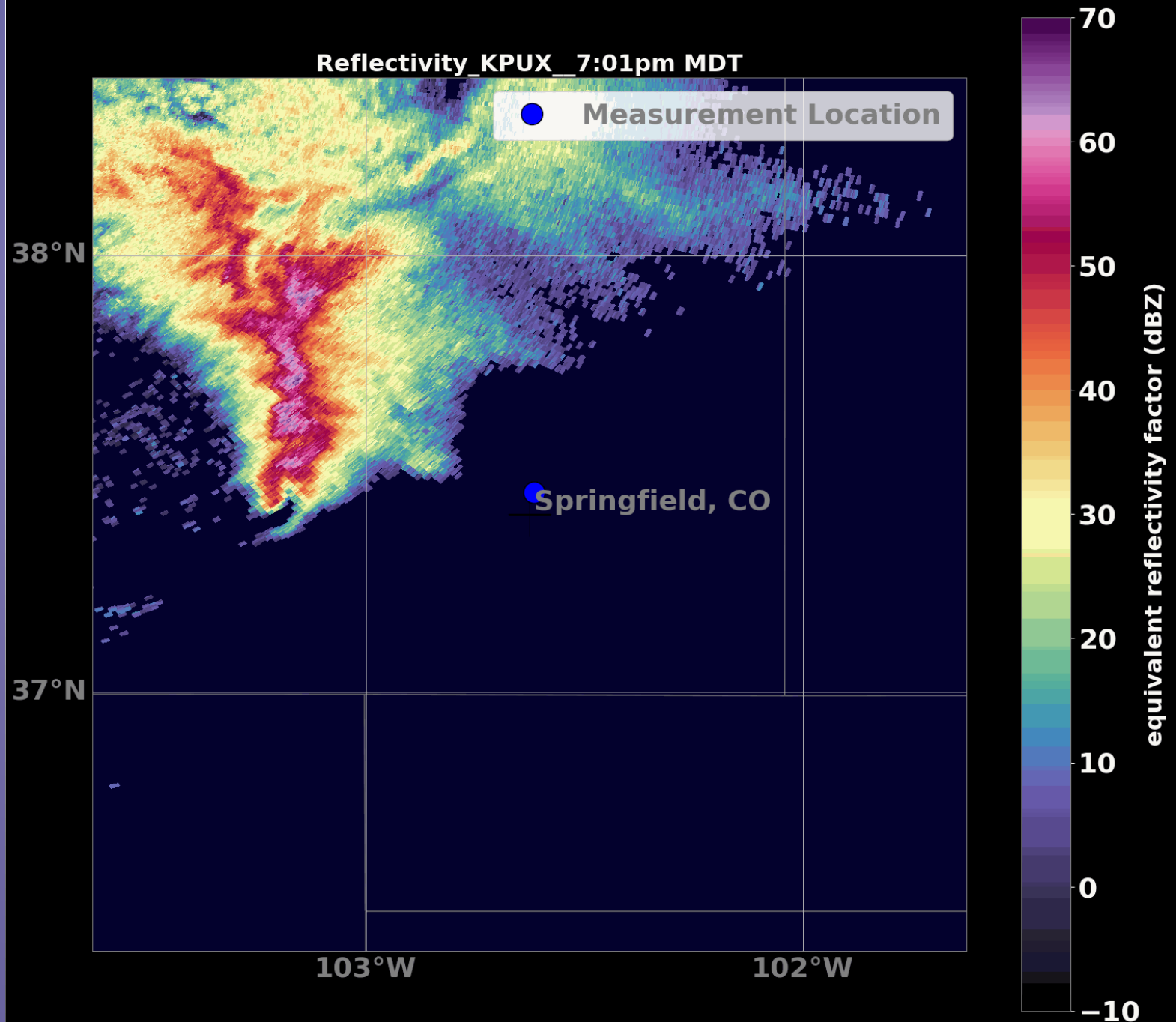
Springfield, CO

June 16th, 2023

Supercell on southern
end of eastward
propagating MCS

IBHS Teams
documented transect
of hail swath through
Springfield

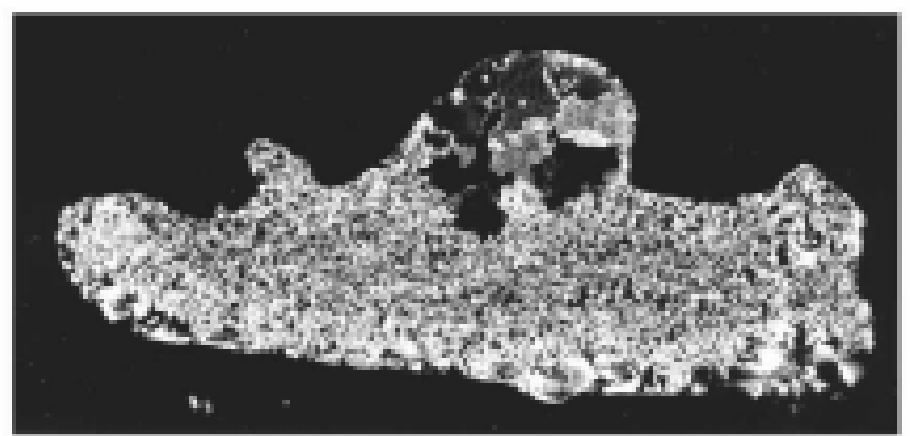
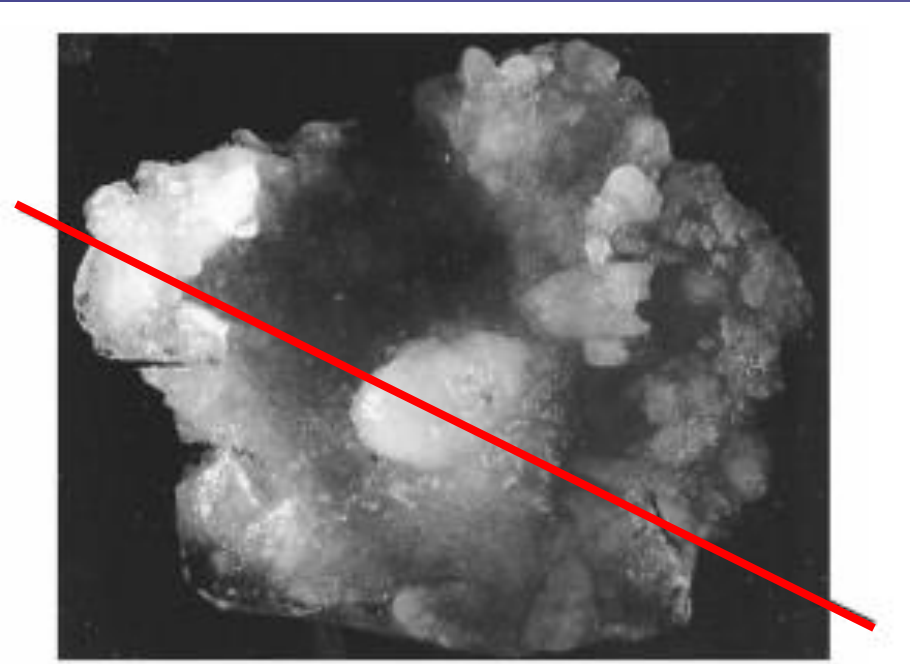
Significant hailstones
characterized by
extremely low
compressive strength



2023 Springfield, CO



2006 Boulder, CO



Super Soft Ice Recipe

| | |
|-----------------------|---------|
| Diffusion Temperature | 45 F |
| Diffusion Pressure | 30 psi |
| Diffusion Time | 16 hrs |
| Freeze Temp | 20-25 F |
| Freeze Time | 120 min |
| Thaw Time | 20 min |
| Condition Time | 60 min |

Diffusing

Diffusion Tank Status: **Diffusing CO₂**

Delay Time: 0.01 hrs Elapsed: 0:50:21
Diffusion Time: 16 hrs Elapsed: 14:20:50
Target CO₂ Level: 2,500mg/l Actual: 3,498mg/l

Delay/Diffusion Progress: 

Actual Pressure: 30.6 psi
Diffusion Pressure: 30 psi
Hold Pressure: 30 psi

Remaining Fills: 0 of 6

Actual Temp: 43.1 °F
Diffusion Temp: 45 °F

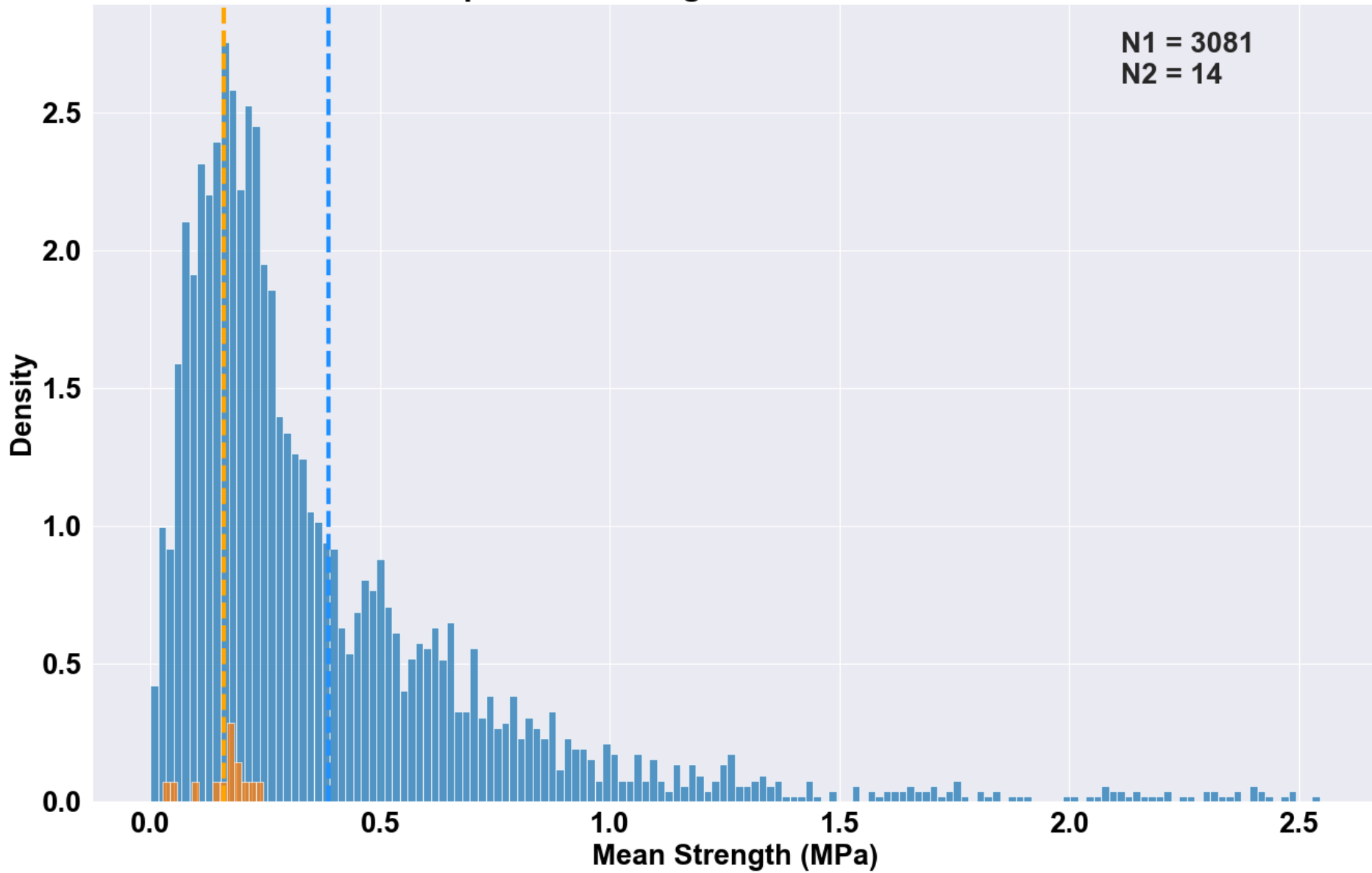
Diffusion Started:
Oct 7, 2024, 5:35:37 PM

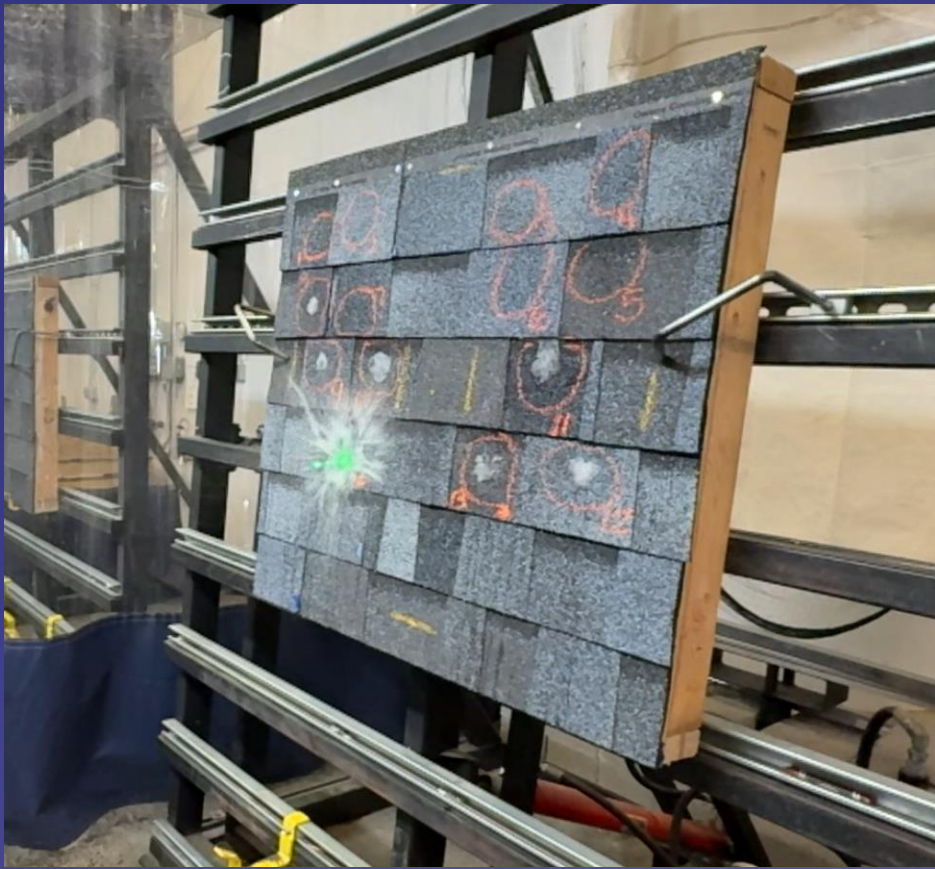
Diffusion Completed:



Process Recipe Fault

Compressive Strengths of Natural Hailstones

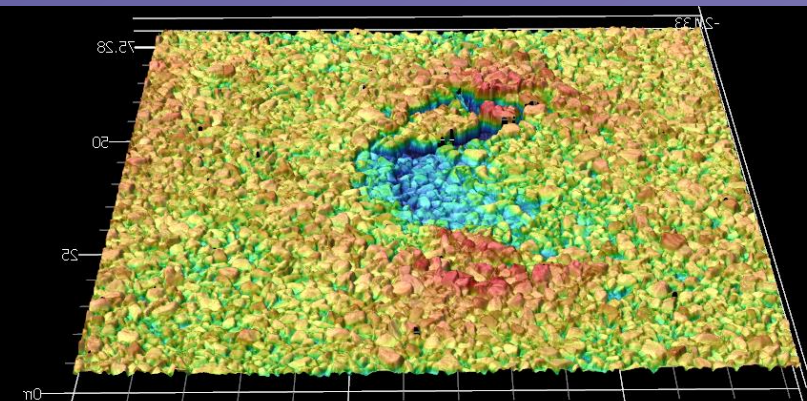
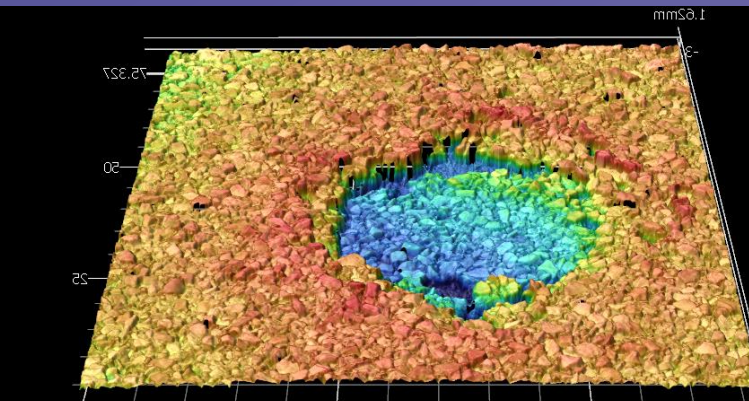
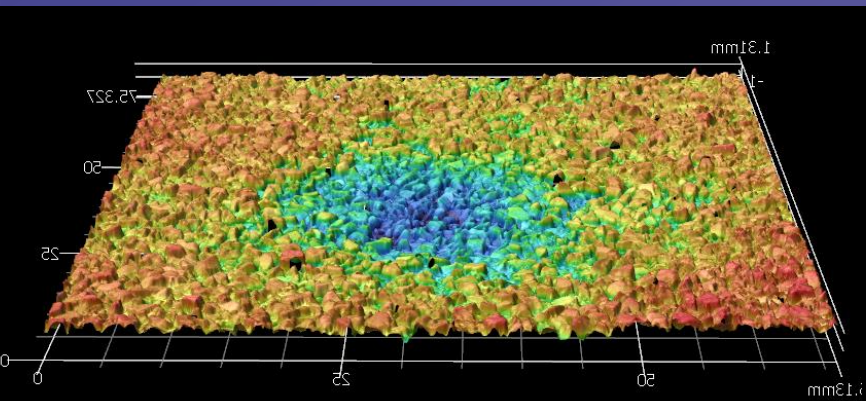




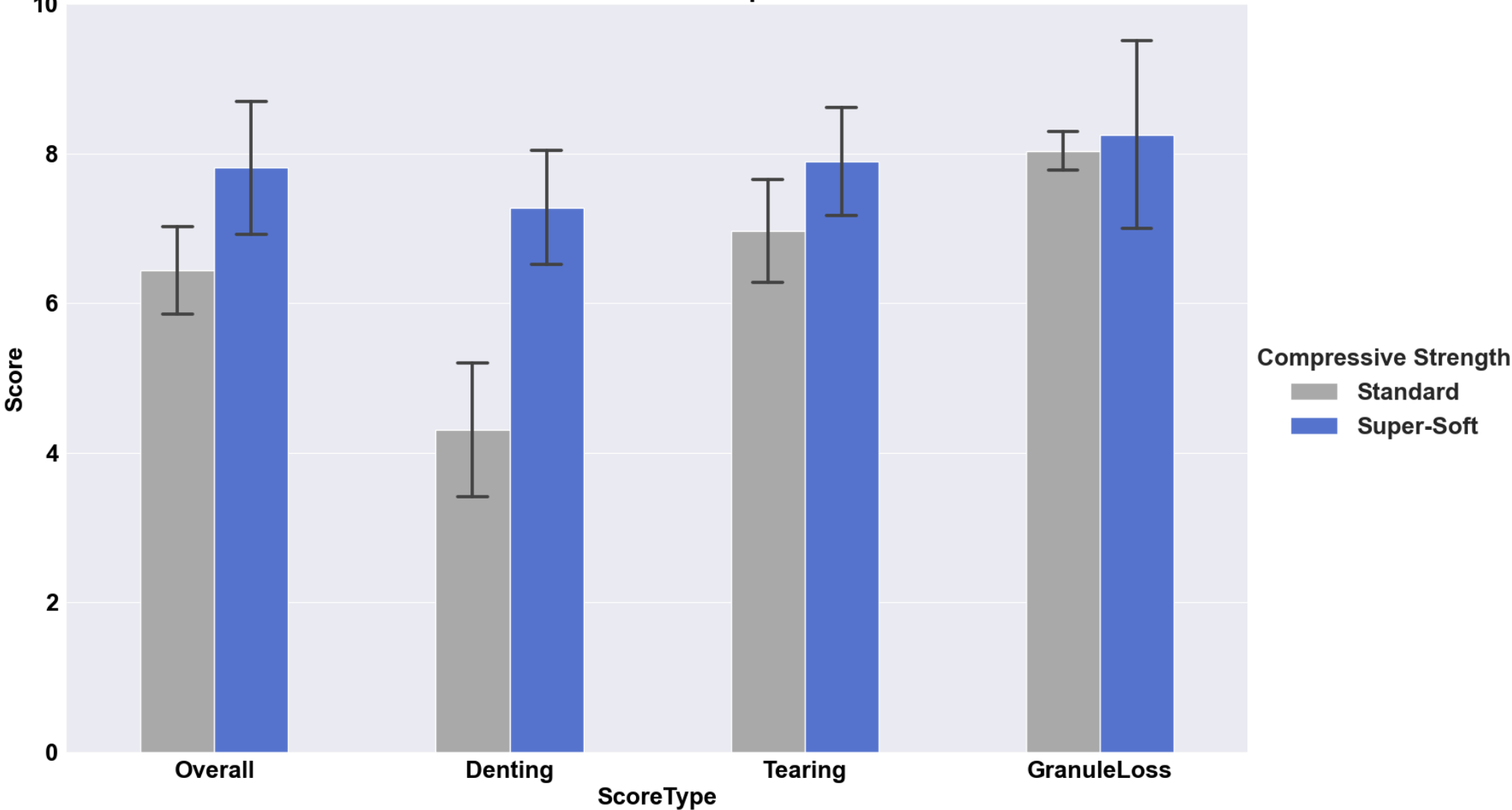
Product 1



Product 2



Product Performance to Super-Soft Hail

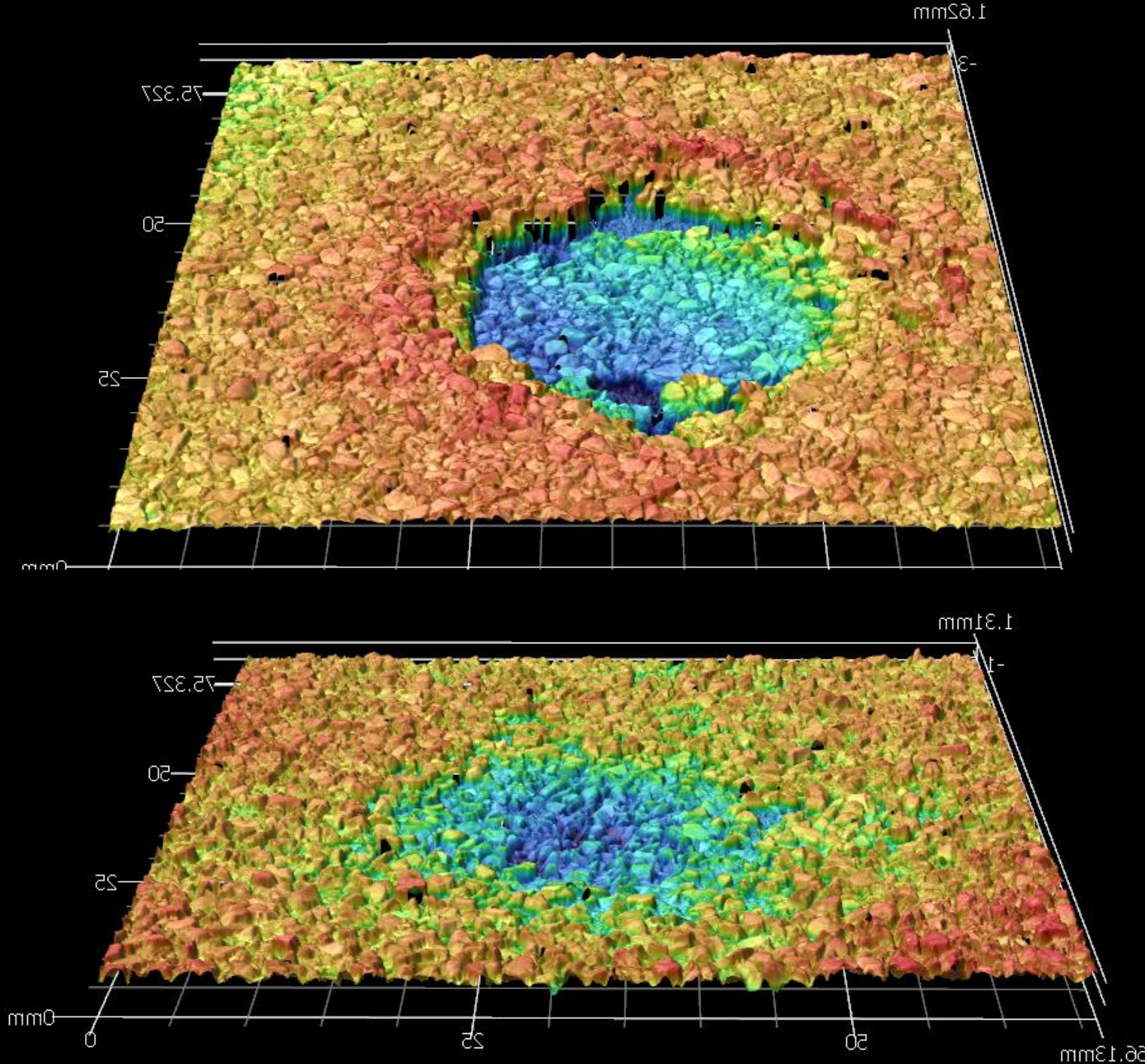


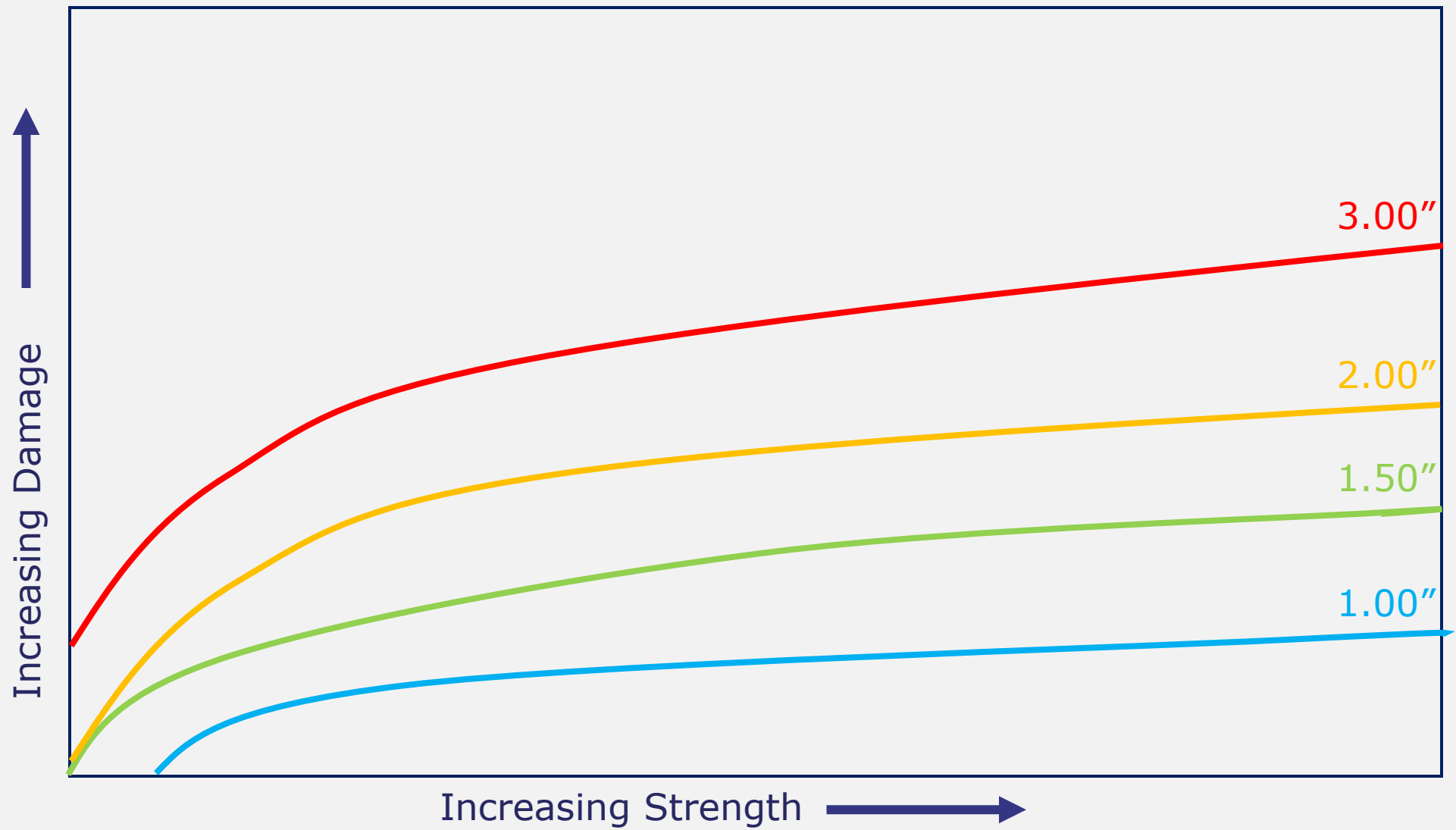
Discussion

A reduction in damage potential for softer stones is an expected result

A greater distance of deformation yields a lower force

Is there a kinetic energy threshold that overwhelms compressive strength and damage persists?







➔ ibhs.org



🐦 [IBHS_org](https://twitter.com/IBHS_org)