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CLAYMEX SPANISH PROFILE TILE
ICE BALL IMPACTING
ANSI FM 4473
HAAG FILE: 5111000240-142/198

CLAYMEX BRICK & TILE INC
9040 IH 35 N
NEW BRAUNFELS TX 78130

ATTENTION: MR PAUL WARTCHOW
SALES MANAGER

JULY 18, 2011

Scott J. Morrison
Jul 18 2011 3:40 PM

HAAG Engineering

HAAG Engineering

4949 West Royal Lane
Irving, TX 75063
214-614-6500
800-527-0168
Fax 214-614-6501
haagengineering.com

July 18, 2011

Claymex Brick & Tile, Inc.
9040 IH-35 North
New Braunfels, TX 78130

Attention: Mr. Paul Wartchow
Sales Manager

Re: Claymex Spanish Profile Tile
Ice Ball Impacting
ANSI FM 4473
Haag File: 5111000240-142/198

In accordance with your request, we impacted Claymex Spanish Profile Tile according to the American National Standards Institute (ANSI) and Factory Mutual Approvals (FM) *Test Standard for Impact Resistance Testing of Rigid Roofing Materials by Impacting with Freezer Ice Balls*, *ANSI FM 4473.*

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DESCRIPTION

Claymex Spanish Profile Tiles were received in our Irving, Texas, laboratory on January 11, 2011. Tiles were orange-colored. Top surfaces were embossed with a fabric-like finish. Individual tiles measured approximately 9-3/4 inches wide by 16-1/4 inches long by 1 inch thick at noses, and weighed approximately 6.03 pounds.

LABORATORY PROCEDURE AND FINDINGS

Tile surfaces were examined closely, both before and after misting with water, to discern cracks. Those without cracks were applied over a test panel. The panel measured approximately 4 feet by 4 feet and comprised 2x4 (nominal) lumber (seven members: perimeter elements and three quarter-span braces) to which solid decking, 3/4-inch-thick plywood, was nailed and covered by one ply of No. 30 asphalt-saturated felt. Tiles were secured each by one screw. Head laps for tiles measured approximately 3 inches. Tiles were conditioned for more than 24 hours and tests were performed at 72°F plus or minus 3°F. Only four tiles on the interior of the middle course were impacted to ensure typical field tile support conditions.

Tiles were impacted with molded ice spheres propelled by the Haag IBL-7 at no less than free-fall speeds of normally occurring hailstones of the same size. Impacts were made by two sizes of ice balls. Target weights, speeds, impact energies, and classes of freezer ice balls are listed in Table 1.

Table 1. Summary of ice ball target weights, speeds, impact energies, and classes.

SIZE (IN)	TARGET WEIGHT (LB_m)	TARGET SPEED (FPS)	TARGET SPEED (MPH)	TARGET IMPACT ENERGY ($FT\text{-}LB_f$)	CLASS
1-1/2	0.0584	92.5	63.1	7.77	2
1-3/4	0.0928	101.8	69.4	14.95	3

Projectile weights and projectile speeds were measured, the latter by a Chrony Gamma Master Chronograph, and impact energies were calculated. Projectiles were launched perpendicularly against the tiles at field, edge, and corner targets. Double impacts were made at each target location within 1/2 inch of one another. Immediately after an ice ball had struck a tile the impact area was marked. See target locations delineated on Figure A-1 appended as Attachment A; representative photographs also are included in Attachment A. Findings for ice ball impacts are listed in Table 2.

Table 2. Findings of ice ball impacts.

TILE REF. NO.	ICE BALL IMPACT NO.	IMPACT LOCATION	SIZE (IN)	WEIGHT (LB_m)	SPEED (FPS)	IMPACT ENERGY ($FT\text{-}LB_f$)	FINDINGS
1	1	Corner	1-1/2	0.0585	95.03	8.21	No distress
	1A	Corner	1-1/2	0.0595	94.49	8.26	No distress
	2	Edge	1-1/2	0.0595	93.13	8.02	No distress
	2A	Edge	1-1/2	0.0600	95.30	8.47	No distress
	3	Field	1-1/2	0.0605	92.78	8.09	No distress
	3A	Field	1-1/2	0.0585	92.53	7.78	No distress
2	1	Corner	1-1/2	0.0590	92.25	7.80	No distress
	1A	Corner	1-1/2	0.0605	93.27	8.18	No distress
	2	Edge	1-1/2	0.0590	91.69	7.71	No distress
	2A	Edge	1-1/2	0.0585	94.59	8.14	No distress
	3	Field	1-1/2	0.0605	93.55	8.23	No distress
	3A	Field	1-1/2	0.0605	93.80	8.27	No distress
3	1	Corner	1-3/4	0.0930	99.02	14.17	No distress
	1A	Corner	1-3/4	0.0960	98.12	14.36	No distress
	2	Edge	1-3/4	0.0940	101.70	15.11	No distress
	2A	Edge	1-3/4	0.0960	101.90	15.49	No distress
	3	Field	1-3/4	0.0940	104.00	15.80	No distress
	3A	Field	1-3/4	0.0975	103.90	16.36	No distress
4	1	Corner	1-3/4	0.0935	103.60	15.60	No distress
	1A	Corner	1-3/4	0.0940	102.90	15.47	Fracture
5	1	Corner	1-3/4	0.0930	103.90	15.60	Fracture

CONCLUSIONS

Based on our laboratory analysis, we made the following observations and have reached the following conclusions:

1. The Claymex Spanish Profile Tile achieved a Class 2 rating in accordance with the ANSI FM 4473.

2. The tile area most sensitive to impact-caused damage was the corner target.

Respectfully submitted,

HAAG ENGINEERING CO.

Scott J. Morrison
Jul 18 2011 3:40 PM

Scott J. Morrison, P.E.
Texas License 69185
Research Coordinator

Haag Engineering Co.
CA F-311
Expires: 06/30/12

Jeff Green
Jul 18 2011 2:59 PM

Jeffrey R. Green
Senior Research Technician

SJM/JRG:ans

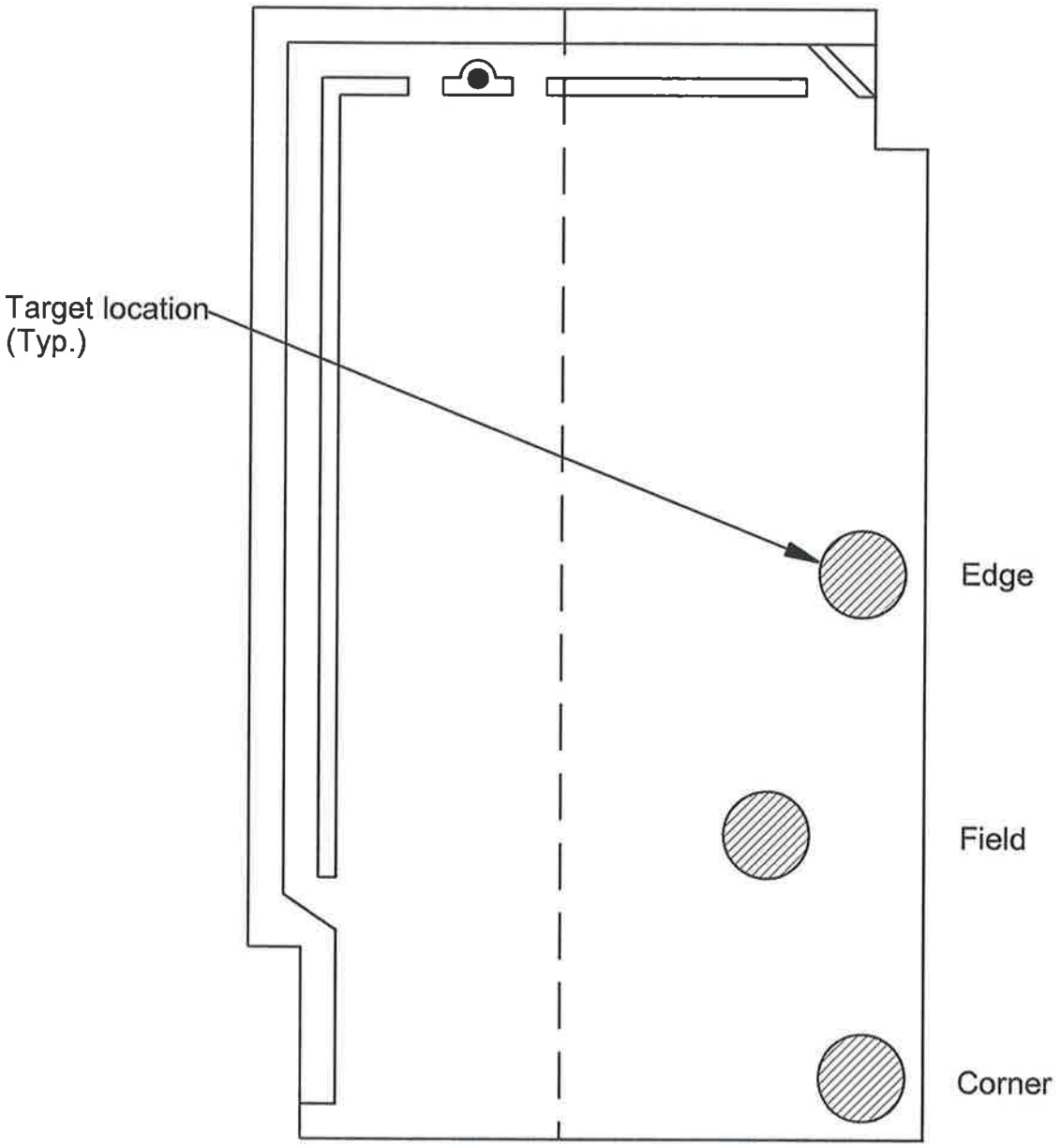
Attachments

HAAG

Attachment A

HAAG Engineering

Figure A-1



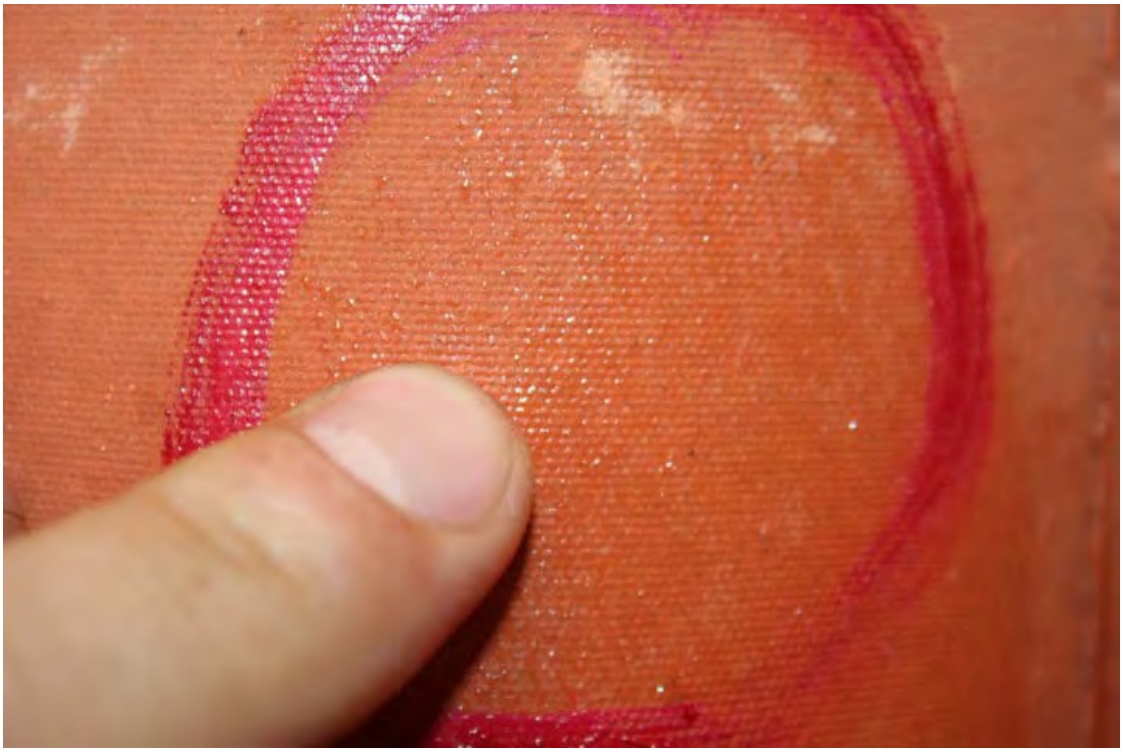
Spanish Profile

A-1. Overview of test setup.

A-2. Overview of test panel with tiles 1, 2, 3, and 4 before impacting.

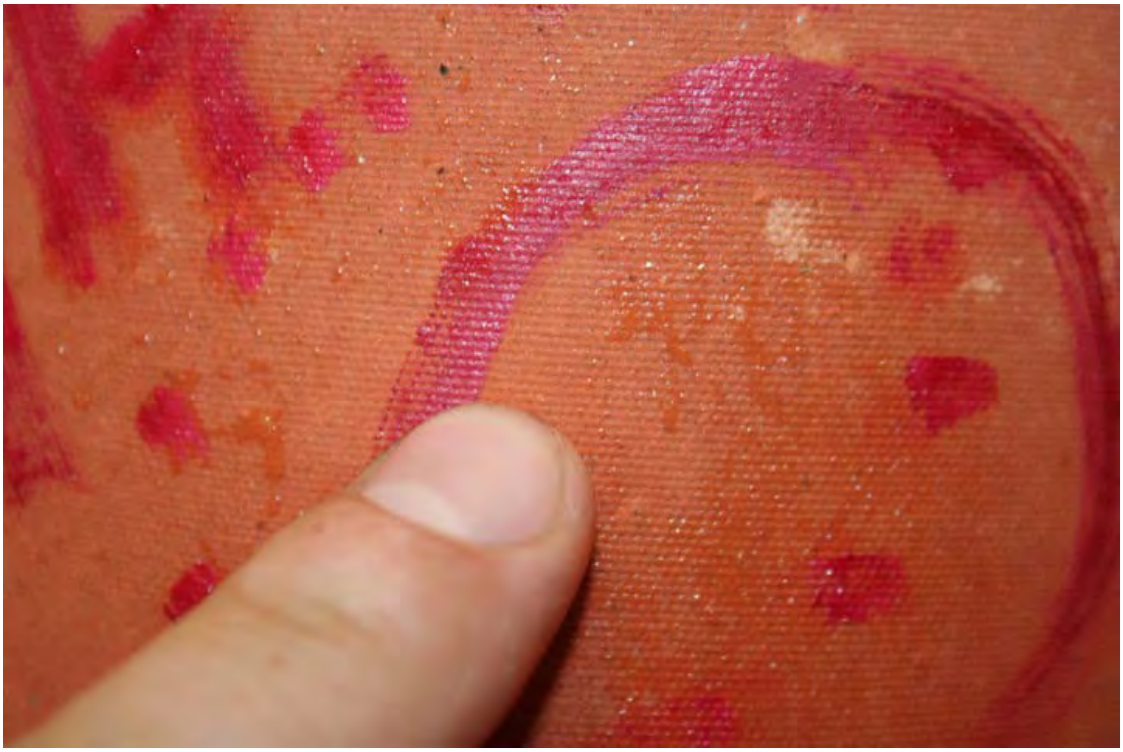
A-3. Top of tile 1 before impacting.

A-4. Tile 1 at impact 1 with 1-1/2 inch ice ball.



A-5. Close up of photograph A-4.

A-6. Tile 1 at impact 1A with 1-1/2 inch ice ball.



A-7. Close up of photograph A-6.

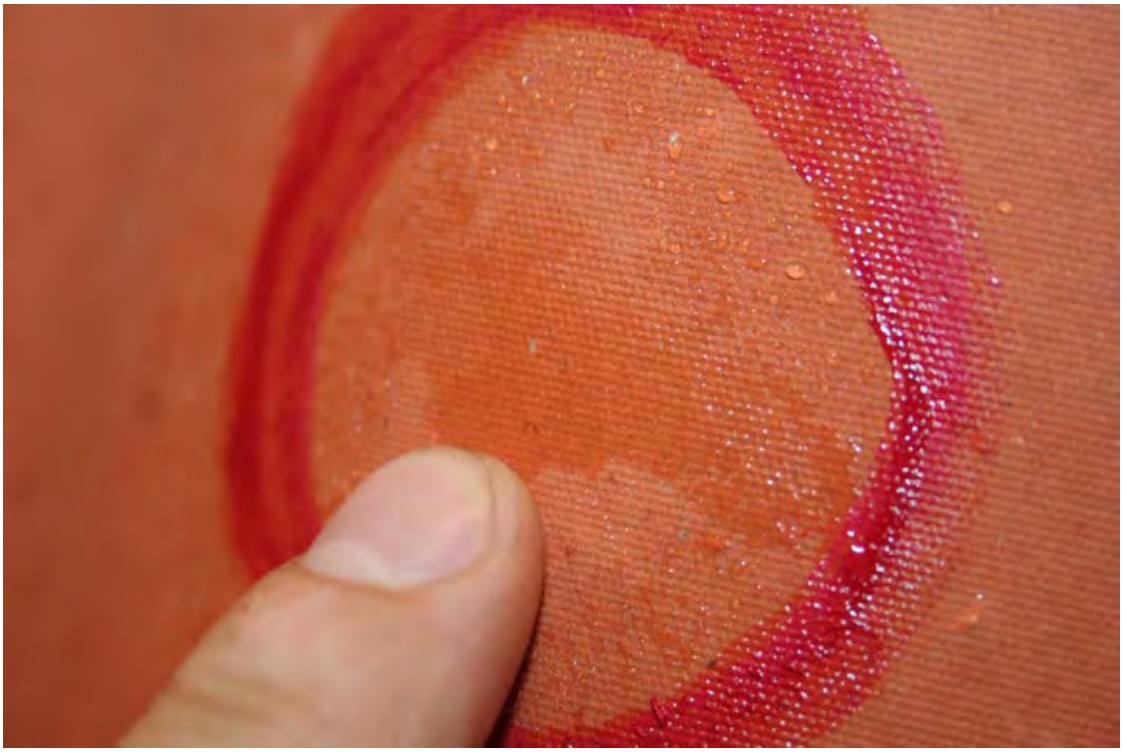
A-8. Tile 1 at impact 2 with 1-1/2 inch ice ball.

A-9. Close up of photograph A-8.

A-10. Tile 1 at impact 2A with 1-1/2 inch ice ball.

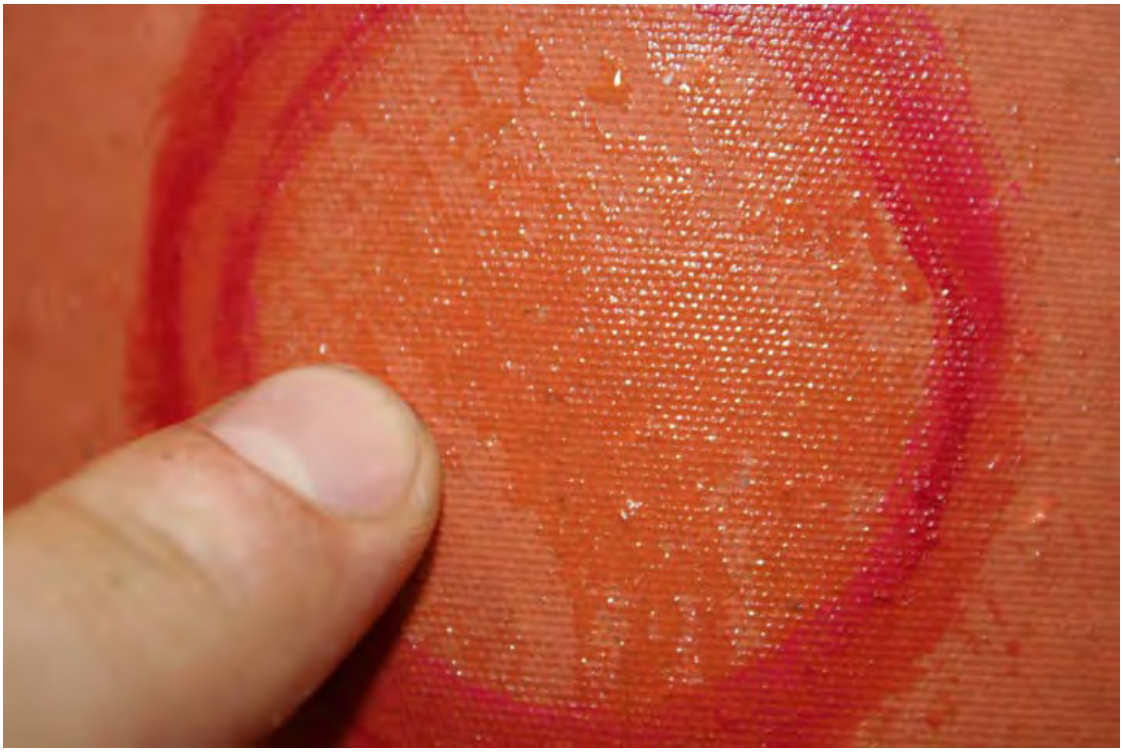
A-11. Close up of photograph A-10.

A-12. Tile 1 at impact 3 with 1-1/2 inch ice ball.



A-13. Close up of photograph A-12.

A-14. Tile 1 at impact 3A with 1-1/2 inch ice ball.

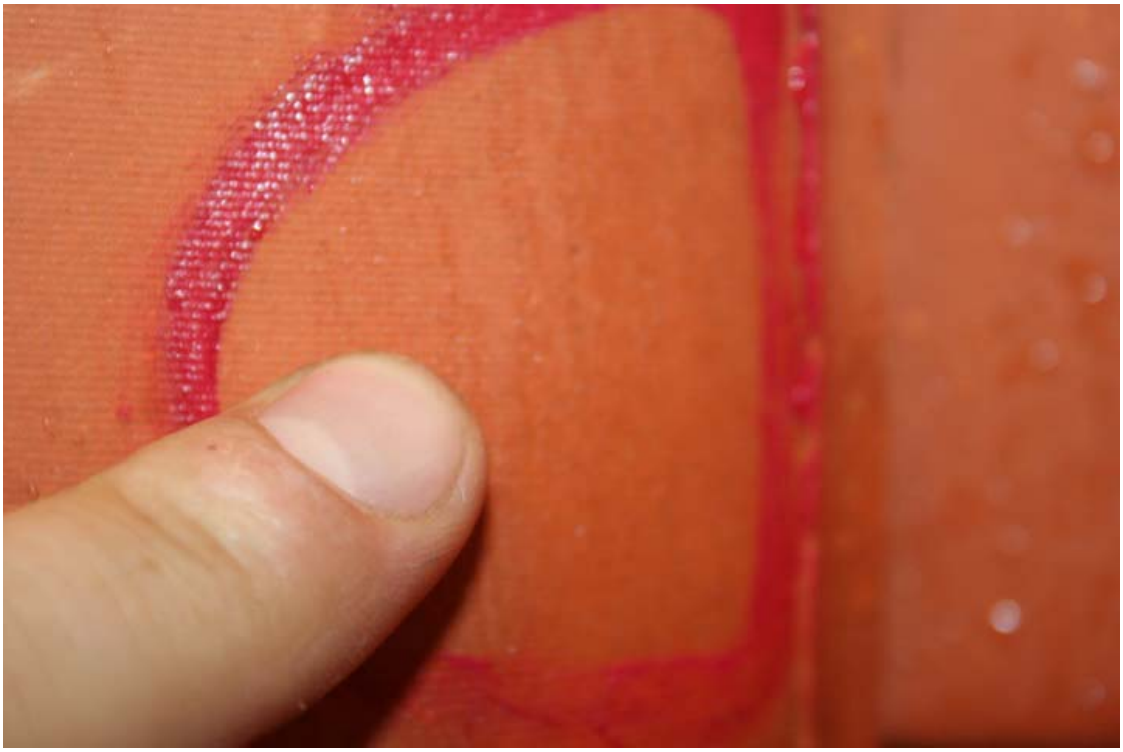


A-15. Close up of photograph A-14.

A-16. Top of tile 1 after impacting.

A-17. Top of tile 2 before impacting.

A-18. Tile 2 at impact 1 with 1-1/2 inch ice ball.

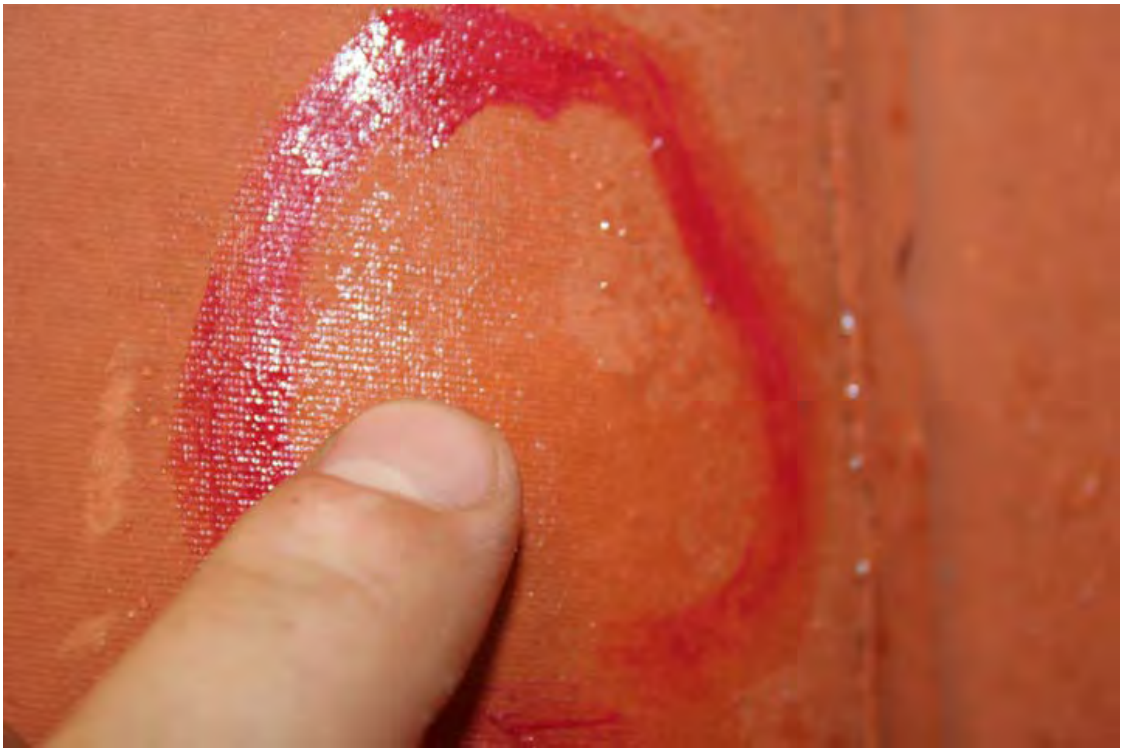


A-19. Close up of photograph A-18.

A-20. Tile 2 at impact 1A with 1-1/2 inch ice ball.

A-21. Close up of photograph A-20.

A-22. Tile 2 at impact 2 with 1-1/2 inch ice ball.

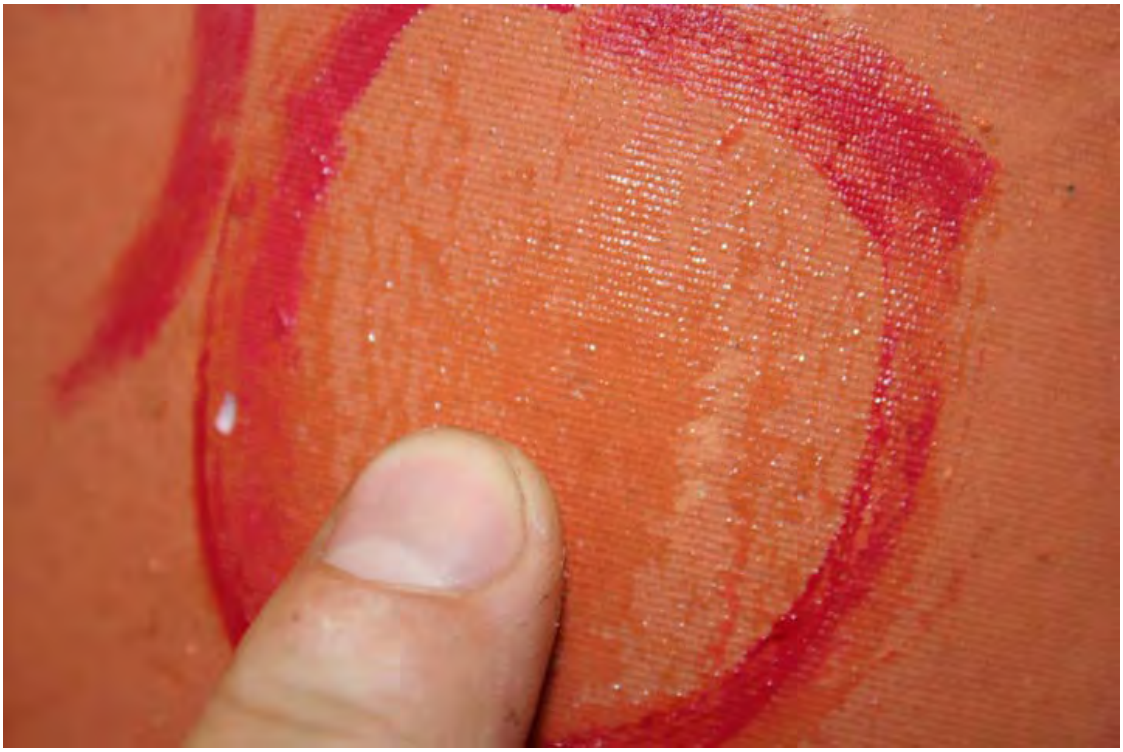


A-23. Close up of photograph A-22.

A-24. Tile 2 at impact 2A with 1-1/2 inch ice ball.

A-25. Close up of photograph A-24.

A-26. Tile 2 at impact 3 with 1-1/2 inch ice ball.



A-27. Close up of photograph A-26.

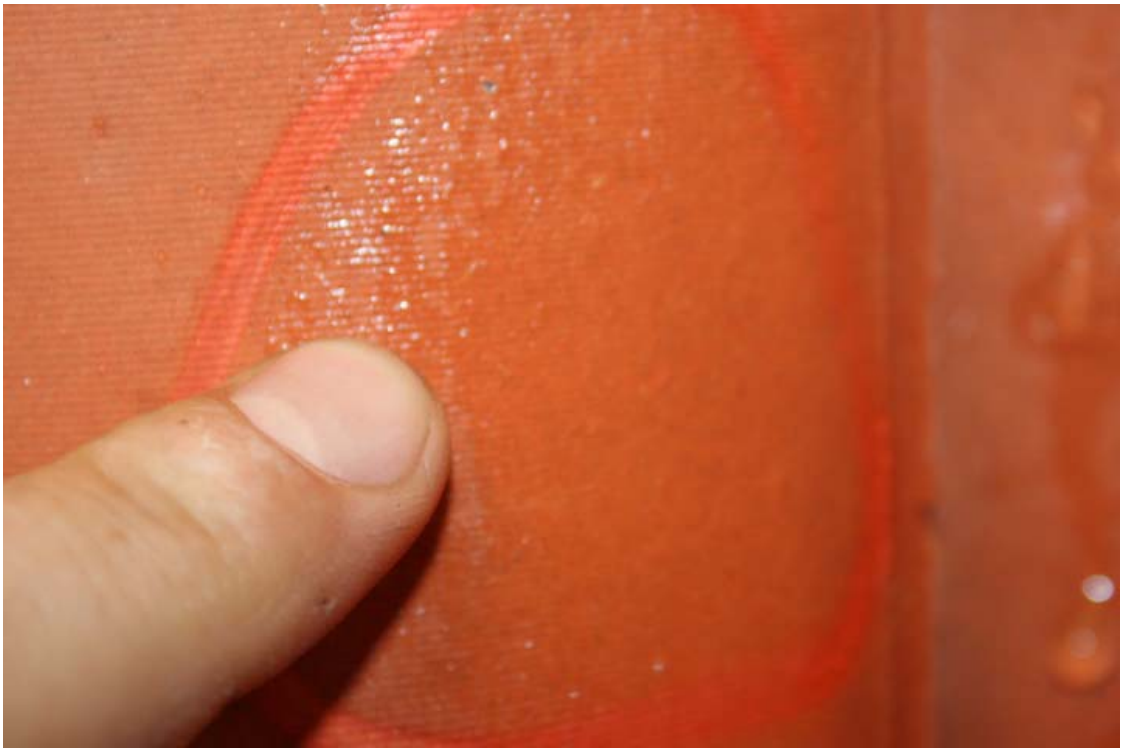
A-28. Tile 2 at impact 3A with 1-1/2 inch ice ball.

A-29. Close up of photograph A-28.

A-30. Top of tile 2 after impacting.

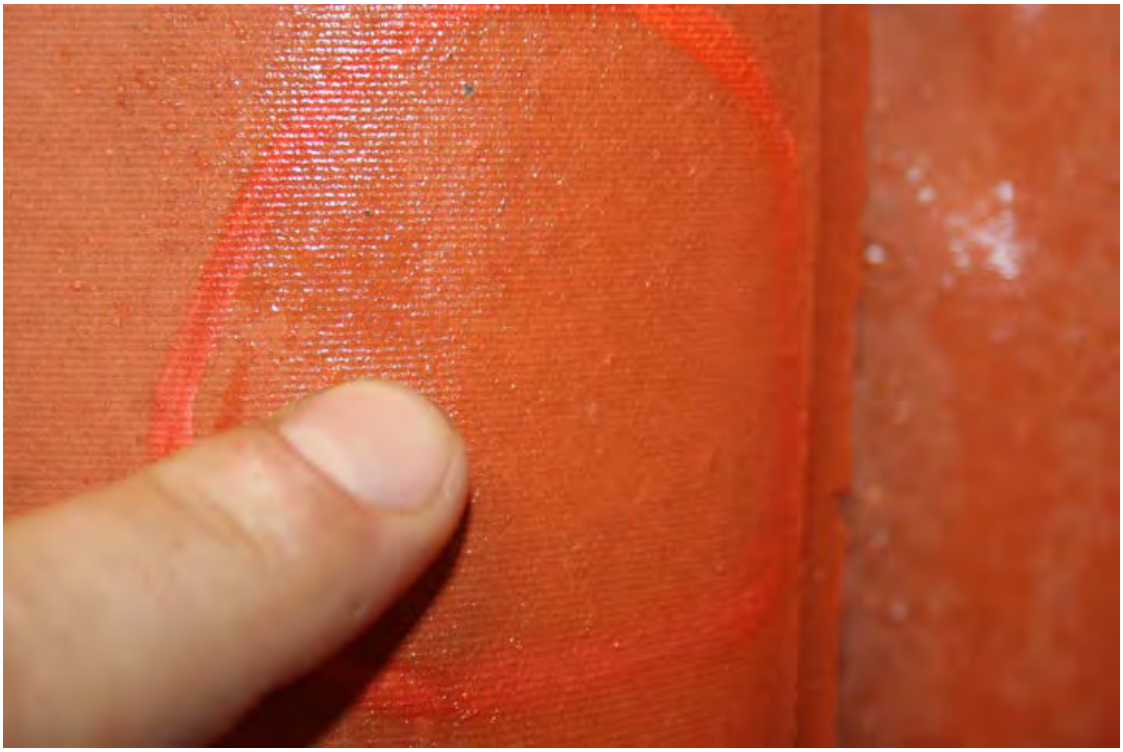
A-31. Top of tile 3 before impacting.

A-32. Tile 3 at impact 1 with 1-3/4 inch ice ball.



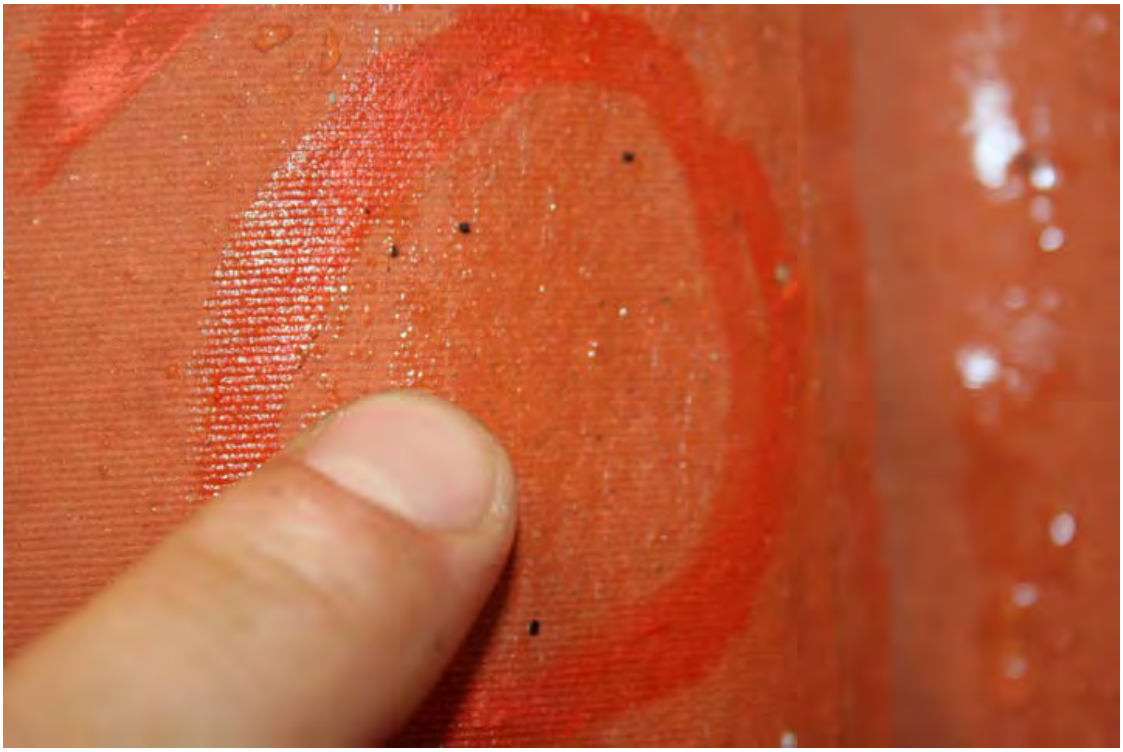
A-33. Close up of photograph A-32.

A-34. Tile 3 at impact 1A with 1-3/4 inch ice ball.



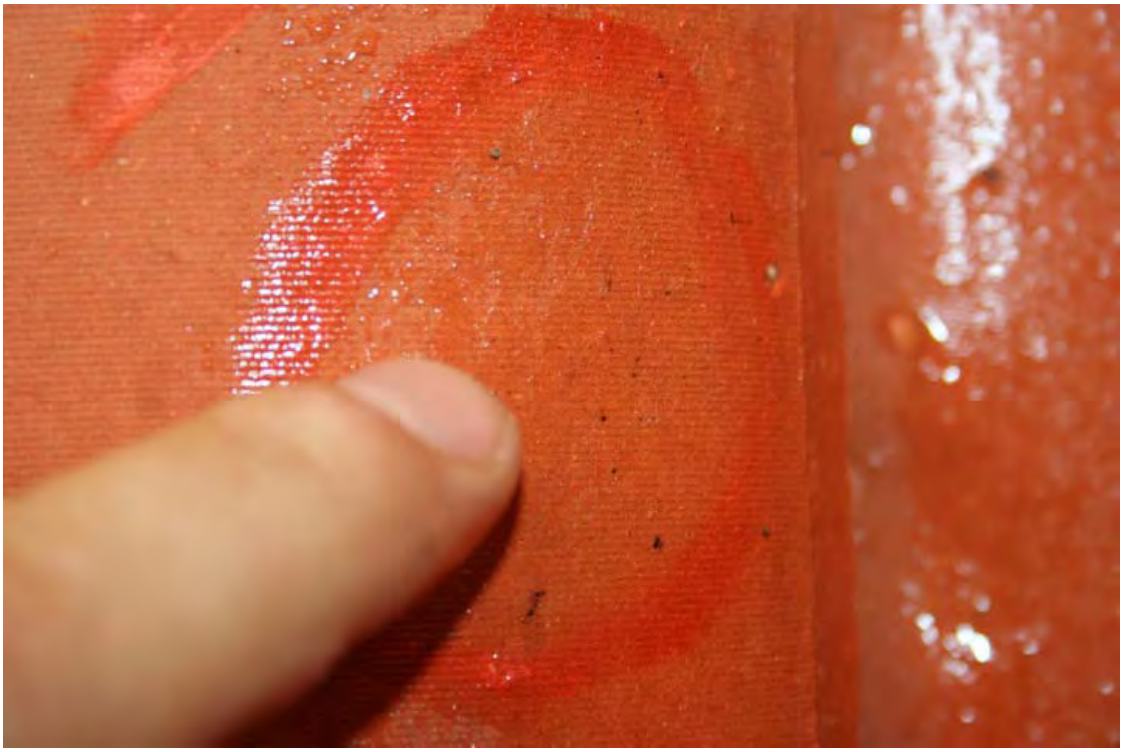
A-35. Close up of photograph A-34.

A-36. Tile 3 at impact 2 with 1-3/4 inch ice ball.



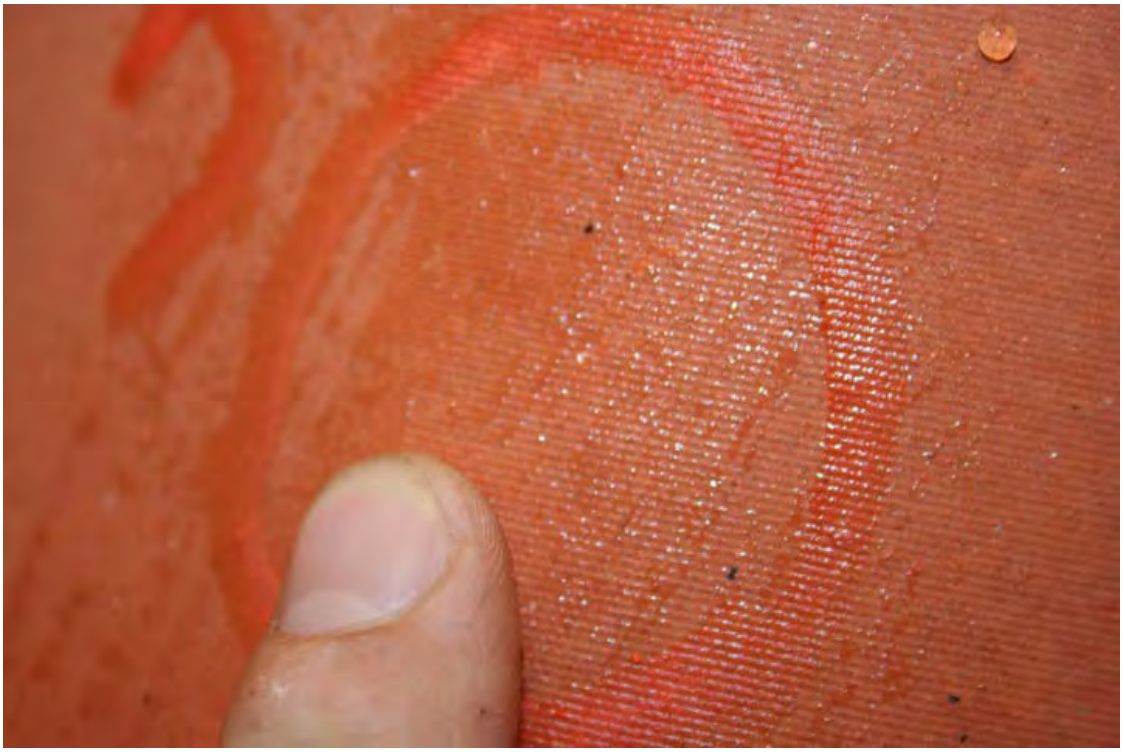
A-37. Close up of photograph A-36.

A-38. Tile 3 at impact 2A with 1-3/4 inch ice ball.



A-39. Close up of photograph A-38.

A-40. Tile 3 at impact 3 with 1-3/4 inch ice ball.



A-41. Close up of photograph A-40.

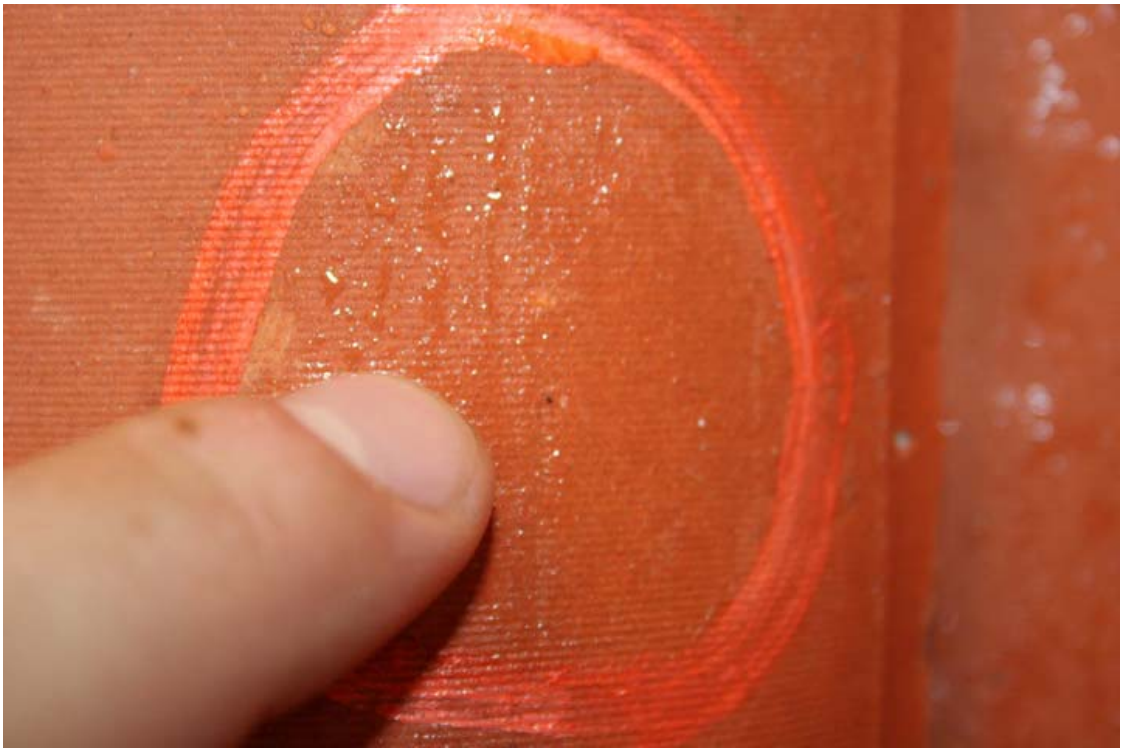
A-42. Tile 3 at impact 3A with 1-3/4 inch ice ball.

A-43. Close up of photograph A-42.

A-44. Top of tile 3 after impacting.

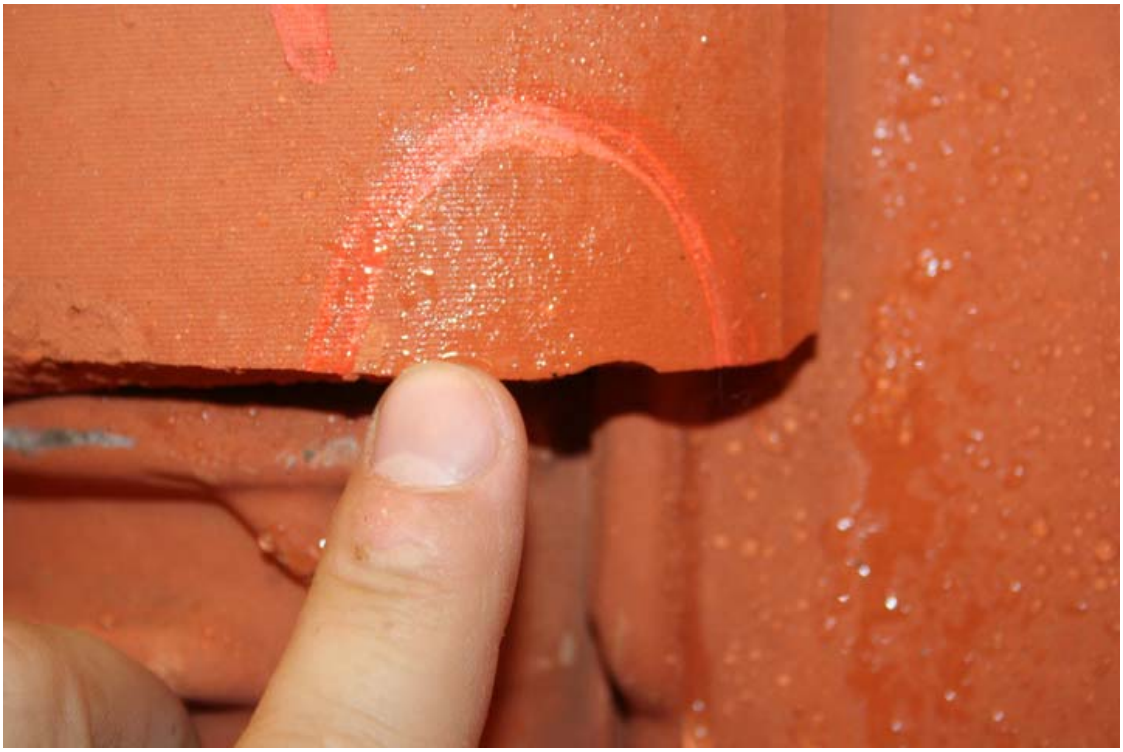
A-45. Top of tile 4 before impacting.

A-46. Tile 4 at impact 1 with 1-3/4 inch ice ball.



A-47. Close up of photograph A-46.

A-48. Tile 4 at impact 1A with 1-3/4 inch ice ball; note fracture.

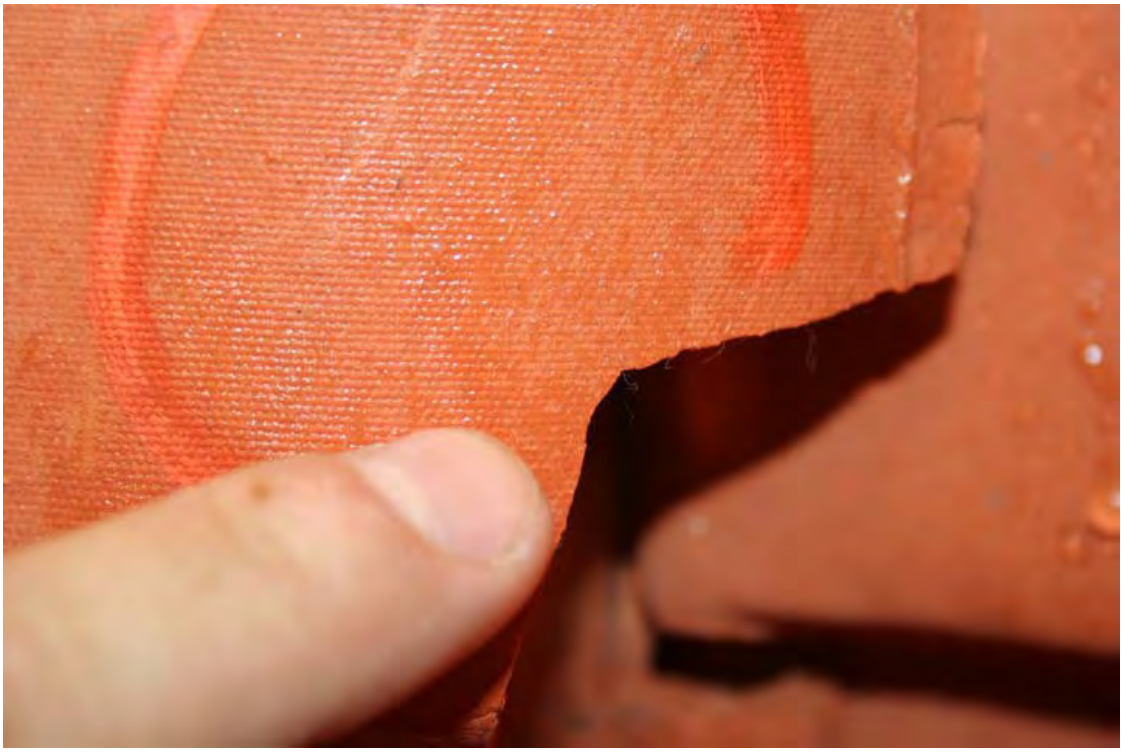


A-49. Close up of photograph A-48.

A-50. Top of tile 4 after impacting.

A-51. Top of tile 5 before impacting.

A-52. Tile 5 at impact 1 with 1-3/4 inch ice ball; note fracture.



A-53. Close up of photograph A-52.

A-54. Top of tile 5 after impacting.