EXECUTIVE SUMMARY

The Effects of Hail Impacts on the Durability of GALVALUME® SSR Panels

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Industry experts on behalf of the Metal Building Manufacturers Association (MBMA) recently completed two research studies characterizing the effects of hail impacts on 55% Al-Zn alloy-coated steel standing seam roof (SSR) panels (GALVALUME® is an internationally recognized registered trademark of BIEC International, Inc. or one of its licensed producers. Other trade names are also used for this coating globally). The studies were undertaken to determine if these roof panels experience "functional" damage from hail impacts due to metallic coating cracking or ponded water in hail divots that might create conditions for accelerated corrosion.

Specifically, the studies were conducted to evaluate 1) coating damage due to common roof panel system designs and manufacturing methods (rollforming) as a baseline to compare against coating damage from hail impacts and 2) water ponding drying rates of simulated hail-impact divots compared to drying rates associated with normal panel mechanical deformations and sheared-edge panel eaves.

Coating Damage: The coating damage study is based upon a metallographic assessment of rollformed profile rib specimens from a 43-year-old roof in Denver [1]. The profile of the Denver roof is representative of trapezoidal standing seam metal roofing that is common industry wide. The results show that a minor degree of metallic coating crazing may occur immediately upon manufacture and may even occasionally penetrate through the coating to expose the base steel, but that no detrimental corrosion has occurred on this roof for over 40 years. This observation is consistent with the unique and well-documented corrosion resistance mechanism characteristics of 55% Al-Zn alloy-coated steel globally.

This study also demonstrated that the occasional minor degree of rollformed coating damage is much smaller in size than the size of 55% Al-Zn alloy-coated steel uncoated spots of up to 0.079 inches in diameter which, upon exposure to marine, industrial and rural atmospheres, showed no adverse effects on corrosion resistance after 9 years. In addition, the degree of coating damage associated with a recent hailstorm "functional" damage insurance claim was about 50 times smaller than the coating damage associated with rollforming on the 43-year-old Denver roof. Thus, it is concluded that such minute coating cracks or base steel exposures from hail impacts do not rise to the level of "functional" damage when compared to the degree of coating crazing which may occur on newly produced 55% Al-Zn alloy-coated steel roof panels.

Water Ponding: The water ponding study is based upon a controlled laboratory assessment of the time required for water to evaporate from simulated hail divots in a commercially produced GALVALUME standing seam panel [2]. A standard laboratory impact testing apparatus was used to produce simulated hail divots by delivering energy impacts of 1, 4, 8 and 13.3 ft-lbs, energies which correlate with hail stone diameters of about 1 to 1-3/4 inches striking a surface at terminal velocity. The resulting divots ranged in depth from 0.035 to 0.159 inches. To put this in perspective, hail stones measuring up to about 1-3/4 inches in diameter have been documented as

representing about 75 to 95% of the hail stone diameters associated with hailstorms in the U.S. and Canada [2].

The study shows that the time for water to evaporate from 0.150-inch divots is faster than the times for evaporation to occur at intentionally manufactured mechanical deformations associated with panel flutes employed to strengthen roof panels. For hail divots up to about 0.160-inch depth, water evaporates in a small fraction of the time required for the sheared-edge panel eave to dry.

Based on these results, any argument that divots produced by hail stones up to about 1-3/4-inch diameter will result in accelerated corrosion of the 55% Al-Zn alloy-coated steel panel due to ponding water in the divots is not supported. Such 55% Al-Zn alloy-coated steel SSR systems featuring flutes and sheared-edge conditions have performed excellently in service for over 40 years.

Overall Conclusions: The results of these two studies clearly demonstrate that impacts from hail stones up to about 1-3/4-inch diameter, while possibly resulting in noticeable visual appearance differences, do not impart "functional" damage to the 55% Al-Zn alloy coating or adversely impact the durability of 55% Al-Zn alloy-coated steel SSR panels due to ponding water in divots up to and including 0.160-inch depth.

That is, any metallic coating damage, or microfracture caused by such hail sizes, is significantly less than the occasional coating damage from normal rollforming operations; and typical hail stone divots that hold ponded water dry at about the same time as the water sitting behind mechanical flutes used for panel strengthening and much quicker than sheared-edge panel eave locations. These conditions exist by roof design and have been performing successfully on existing commercial roofs for over 40 years.

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[1] Dutton, R. and Giansante, D.R., "Coating Damage due to Roll Forming of GALVALUME® SSR Panels", Metal Building Manufacturers Association, www.mbma.com, March 1, 2021.

[2] Dutton, R. and Wilson, J., "Water Evaporation Rates of Simulated Hail Divots on a Low-Slope GALVALUME® SSR Panel", Metal Building Manufacturers Association, www.mbma.com, May 30, 2020.