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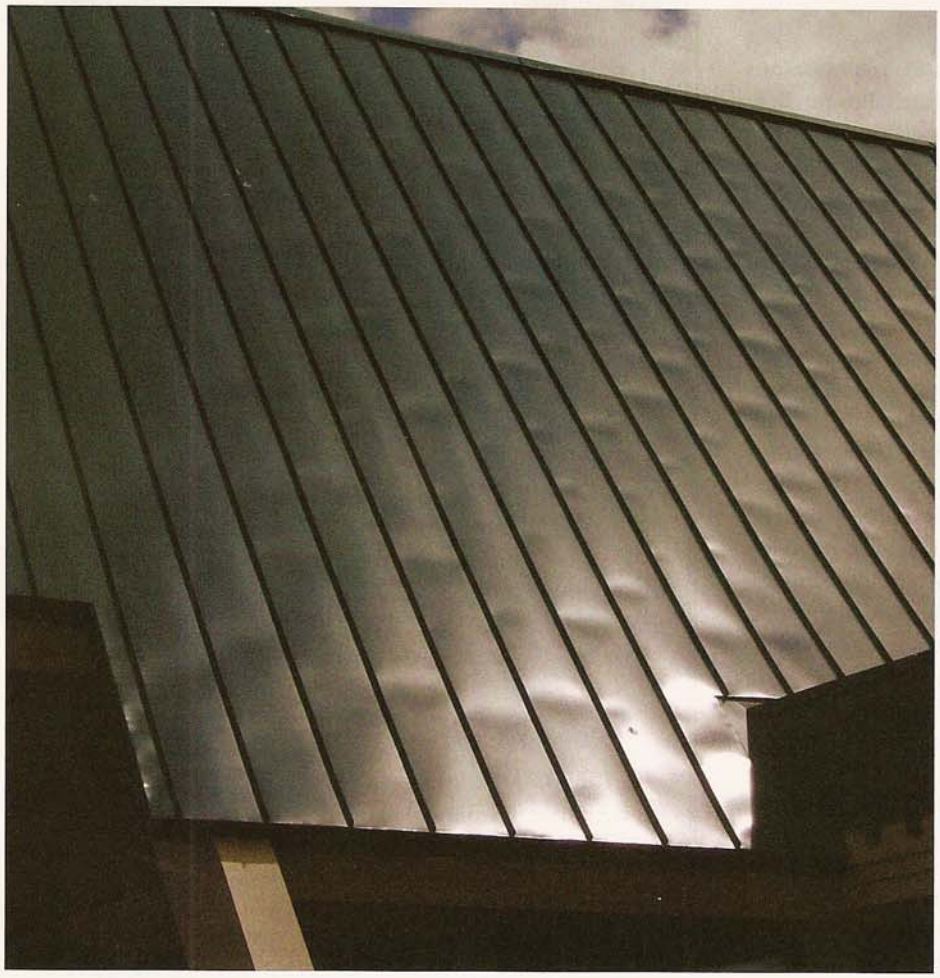

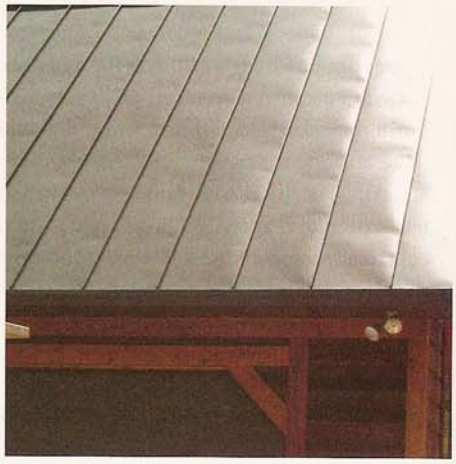

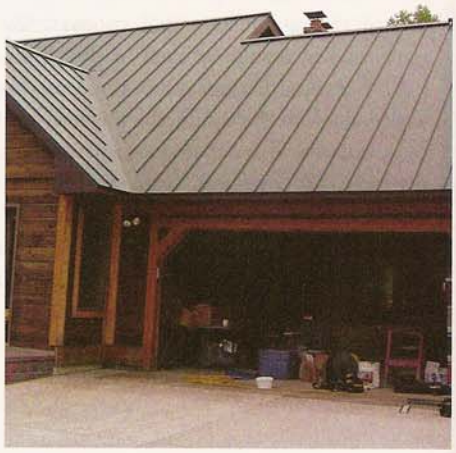

OIL CANNING

LIMITING THE EFFECTS OF MODULATION WITH INSTALLATION PRACTICES

BY DAN PERKINS

A SIGNIFICANT AMOUNT OF research has been done by steel manufacturers and the Metal Construction Association about the causes of oil canning and other characteristics of distortion in applied steel roofing. Much of this research has been done from the perspective of manufacturing practices and what manufacturers can do to limit their exposure to the liabilities inherent in this effect.

It is inevitable a certain amount of oil canning, modulation and distortion will appear in applied steel roofing as the product expands and contracts with temperature. However, there are manufacturing and application principles that can limit the effects and appearance of these conditions and make the overall product more consistently acceptable to customers and architects.

The segment of the industry in the most need of basic information regarding oil canning is onsite rollforming contractors and their machine operators. Inexperience with this issue can result in an entire job run through the machine before the operator has noticed distortion and checked the machine and steel for problems. When roofing contractors buy rollforming machines, they become manufacturers and, as such, assume responsibility for the quality of the products they are manufacturing.

OIL CANNING CLOCKWISE FROM LEFT » The clips pull into the foam enough to telegraph their location when the sun is at a certain angle; 24-gauge, 16-inch pans over 3-inch foam with bearing plates. / This is a rejected job; residential standing-seam, 26-gauge, 21-inch panels, higher gloss. / The same residential job was replaced with 24-gauge, 17-inch panels, low gloss.

Following is a list of the practices Dan Perkins Construction Inc., Ishpeming, Mich., has adopted to reduce the risks of standing-seam roofs that appear excessively oil canned to our customers:

1. Use good quality steel and know how to identify problems with the steel you have purchased. Some of the most common issues found with steel coil include "coil set," a condition where the steel holds the shape of the coil and will not lay flat; "wavy edge," a condition where one or both edges of the steel are longer than the center; "full center," a condition where the center of the coil is longer than the edges; and "camber," a condition where one side of the steel is stretched slightly longer than the other so that if you put two slices of it down next to each other, the edges don't line up. Generally, you can identify and document any of these problems with a 12-foot (4-m) piece of steel, flat surface and camera. In our experience, it is best to use 24-gauge (or heavier) tension-leveled steel coil. A brief experiment using 26-gauge steel resulted in excessive oil canning and some rejection from our customers.

2. Use roofing pans no wider than 18 inches (457 mm). Wider pans tend to show more oil canning.

3. Use minor ribs or striations in pan profile.

4. Use lower-gloss paint finishes. Lower-gloss paints reflect less light and show less distortion.

5. Apply architectural roofing panels over a solid roof deck rather than over foam insulation or existing roofing materials. Make sure the roof deck is straight, and address distortions in the deck with customers so they have a clear understanding of how oil canning can be exacerbated by deck distortions.

6. The use of 3/8-inch (9.5-mm) foam backer rod taped to the back of roofing pans can help eliminate excessive oil canning. We have adopted this technique on 100 percent of our applications because of its effectiveness. Backer rod puts a crown in the panels so distortion is pushed toward the ribs.

7. When site-forming steel, the rollforming machine needs to be kept clean and in good adjustment to minimize variations. Always check to see that all the dies are turning freely because bearings commonly seize. The technician operating the machine must be familiar with the means of adjusting the machine and must watch the panels for crowning in the male or female legs, as well as the angle the ribs make with the pan and length of the top of the male rib. If any of these adjustments are not proper, tension and distortion will result in the applied pan.

PREVENTING OIL CANNING » Three-eighths-inch backer rod can be applied to the center of roof panels starting and ending about 8 inches from each end of the panel. The backer rod is attached every 5 feet or so with a small piece of duct tape, which will adhere well to steel in almost any weather condition. / Backer rod costs about 3 cents per linear foot and can be applied very quickly. It serves as relatively inexpensive insurance against the appearance of excessive oil canning.

8. It is important to ensure freedom of thermal movement when affixing roofing panels to the substrate. Metal expands and contracts with changes in temperature. It is crucial that metal roofing panels are fixed soundly to the substrate at only one point and that they are allowed to expand and contract from that point outward. If there are multiple points of fixity, the panels will buckle and distort as they attempt to move through their thermal expansion cycles.

When addressing this last point, we typically anchor the panels at the ridge and allow the movement to work in a downward direction. Some systems, especially on larger commercial applications, specify anchoring at the eaves or even at the mid-span.

It is inevitable a certain amount of oil canning, modulation and distortion will appear in applied steel roofing as the product expands and contracts with temperature.

A roof system's ability to expand smoothly depends on its attachment design. A snap-lock system that is attached to the substrate through nail slots in the male rib can contract over the length of the nail slot only if the screws are centered in the slot and not fully tightened. A single-lock standing-seam system will allow some movement of the panels around fixed clips but not much. A double-lock system effectively locks the clip into the panel and allows hardly any movement of the panel past the fixed clip. Sliding clips allow the panel to move the distance of the track that is built into the clip and is a reasonable substitute for fixed clips on longer runs. We typically switch from fixed clips to sliding clips on runs more than 40 feet (12 m) on our single-lock applications.

The change in length of a metal roofing panel is defined by the change in temperature multiplied by the length of the roofing panel times the coefficient of expansion for the metal of which the panel is made ($\Delta L = L \times \Delta T \times Ce$) . Typically, a 100-foot- (30-m-) long steel roofing pan will grow and contract slightly more than 1 inch (25 mm) through a seasonal temperature cycle. The same pan in aluminum will grow and contract by more than 2 inches (51 mm).

The best way to circumvent issues of distortion resulting from attachment systems is to calculate how much your roof assembly will grow and contract over a thermal cycle for your area and make sure your attachment design is equipped to handle those conditions.

Dan Perkins is president of Dan Perkins Construction Inc., Ishpeming, Mich.