

WHITE PAPER



Selection and Installation of Curbs on Hydrostatic Low-Slope Coated Steel and Aluminum Roofing

Overview

This document describes best practices for the selection and installation of curbs used specifically on low slope (less than 2:12), coated-steel or aluminum roof systems. Steep slope or architectural roofing is not addressed in this document. Different design considerations for curbs are required for steep slope roofing and for materials other than coated steel or aluminum.

General

As recently proven by Metal Construction Association (MCA) field study and research, a properly designed and installed unpainted 55% Aluminum-Zinc alloy-coated steel roof system is capable of providing more than six decades of service life. The key to a “best practice” roof system is much more than just the metal roof panels. The entire roof system consisting of the roofing panels, flashing, fasteners, and other ancillary accessories, such as curbs, should be designed and constructed in accordance with best practices so that all components work together and perform optimally. A weak link in any of the individual parts can compromise the performance of the complete roof system. The same considerations exist for metal roofing systems made from aluminum.

Metal roof systems made from painted or unpainted aluminum, typically alloy 3003 or 3105, have shown excellent field performance similar to the aluminum-zinc alloy coated steel roofing materials described above. In some cases, the choice of aluminum is made due to its excellent corrosion resistance properties in certain harsh environments.

Roof curbs are one type of accessory commonly used on low-slope metal roof systems. A roof curb is basically a framed opening in the roof plane. Roof curbs are comprised of raised flashing and structural members used to support roof appurtenances such as skylights, mechanical equipment, smoke vents and roof access hatches. Curbs present obstacles to the designed flow and drainage of the roof, but a properly designed curb will divert runoff and roof drainage around the curb. (Figure 1)

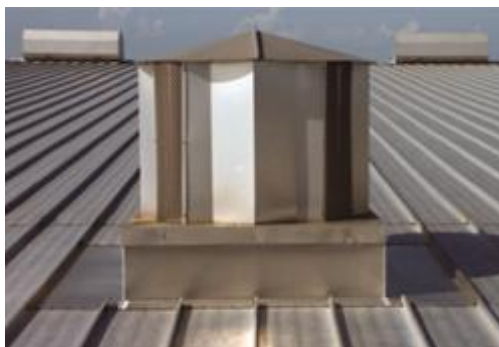


Figure 1: Example of a properly designed roof curb

A properly designed roof curb is accomplished by having small crickets, diverters, or saddles, formed as an integral part of the curb structure. A variety of roof curbs are available as standard accessories, but curbs can also be custom-made for a particular installation. The curb raises the penetration connection above the plane of the roof surface, thereby reducing the possibility of leakage. Curbs can also provide improved and leveled surfaces for attachment of additional roof accessories. Roof curbs are an integral part of a metal roofing system, so performance criteria of the curb is an important design consideration. The long-term performance requirements of the curb should match the service life of the metal roofing system.

Best Practice Materials

Best practice for curbs utilizes continuously-welded 3003 H14 aluminum (0.080” minimum thickness) or 18-gauge stainless steel to create “floating” equipment curbs similar to that shown in Figure 1. Aluminum can be welded with no heat-warp because of its lower melting temperature and the curb flanges are sealed with butyl polymer tape sandwiched between the curb flange and the roof panel. Such an installation, according to today’s best practices, would have a service life that would match or surpass the life of the roof system in most environments. Such curbs (Figure 1) are available from numerous sources within the metal roofing industry. With aluminum or stainless curbs, replacement during the service life of the roof system would not be necessary.

If the curb is not installed correctly, it may not allow for adequate water drainage and may not be able to be properly sealed to the roof.

Improper Materials

Some roofing contractors fabricate curbs made of hot dip galvanized or Galvalume® steel substrates. Generally, these types of curbs do not provide adequate long-term performance. (Figure 2) Galvanized material does not carry a warranty against perforation due to corrosion and can be problematic. Galvalume® substrates carry a 25 year “perforation from corrosion” warranty backed by the producing steel mill. However, curbs made from Galvalume® (or galvanized) steel may not last 25 years because of heat-warp damage to the substrate from welding that is performed on the corners and flanges of the curbs. Additionally, the protective Galvalume® or galvanized coating can be damaged significantly from spot and seam welding in the corners and flanges of curbs. This welding may compromise the long-term corrosion performance of those materials and also void the 25-year warranty. As a further consideration, the curb assembly and appurtenances should not contain any metals galvanically dissimilar to the roof material.



Figure 2: This galvanized curb has already started rusting at the welds in less than one year

If the curb is not installed correctly, it is likely to be the source of roof leaks. (Figures 2 & 3) Therefore, all curb installations should involve the roof installer. Construction documents may indicate that responsibility for the curb installation belongs to other tradesmen or even a joint effort between various trades. If so, it is recommended that the roof installer attempt to get involved to ensure that best practices are being observed. Note that curbs may also be installed after the roof has been installed or even in-service for a period of time. Like new construction, a qualified roofing contractor should be involved with these later curb installations.



Figure 3: Improper Curb Types

Best Practice Installation

The best practice for installing curbs is to use an “over/under” configuration. This is sometimes referred to as a “shingled” curb and is illustrated in Figures 4 and 5. The roof curb is lapped under the roof panels at the upslope end and over the roof panels at the downslope end to avoid “back water” laps. The curb walls are built up to a minimum height of 6” and flanged at the top to provide an adequate structural mounting surface for the equipment. The curb sides are also tapered to compensate for the roof slope and to provide for level mounting of roof equipment. Both ends of the curb are properly shingled with respect to water flow. (Figure 5)

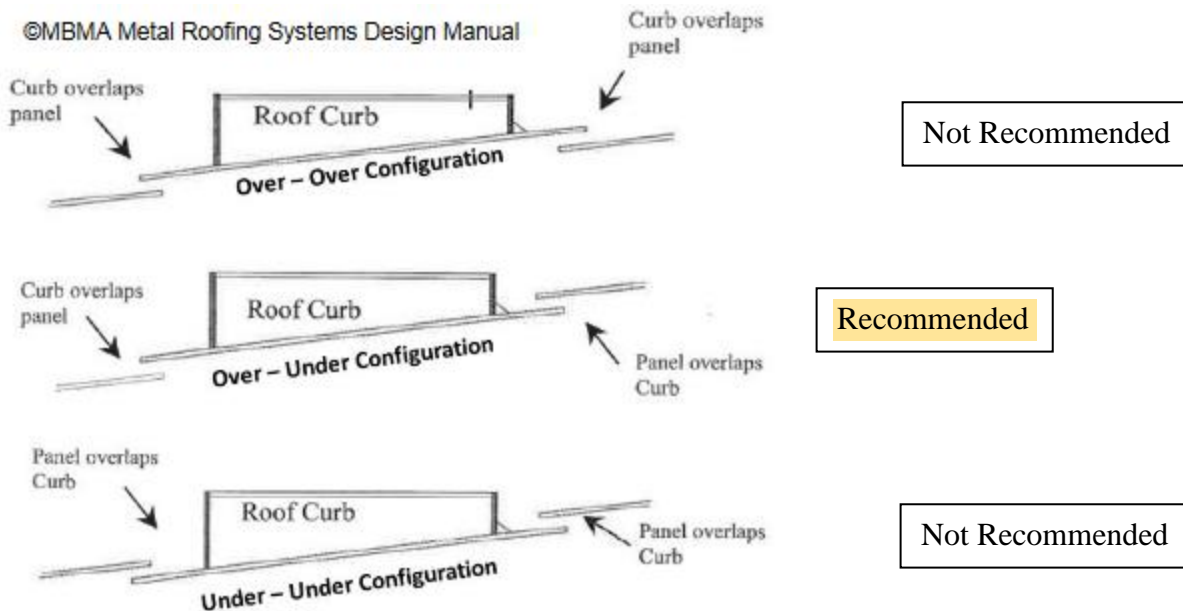


Figure 4: Recommended Roof Curb Installation

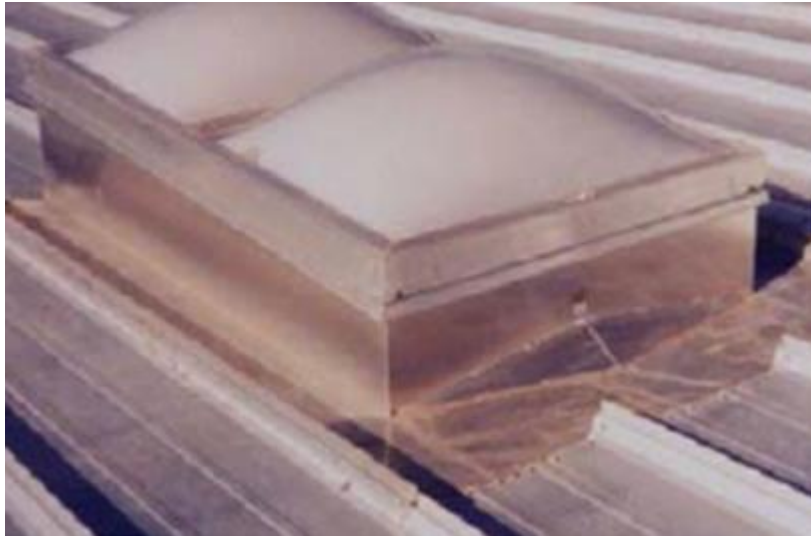


Figure 5: This under/over roof curb allows for the curb to be “shingled” into the roof to prevent roof leaks

The metal roof system manufacturer should always be contacted concerning the use of roof curbs. Some manufacturers offer curbs exactly matching the roof panel profile, simplifying installation and flashing. The manufacturer may also provide a list of recommended curb suppliers. Using a recommended supplier helps avoid warranty issues while ensuring system compatibility, based on their experience and focus on curb performance.

For a new roof installed with a curb, as with every roof installation, it is beneficial to plan out the panel layout to ensure the panels are situated in a conducive arrangement. This includes which panels will be cut short up-slope and down-slope of the curb, which panel will be notched and which panels will be end lapped.

A well-designed curb will have a minimum clearance of 12” between the panel ends and the point of the curb diverter at the upslope end. The sides will have a minimum clearance of 6” between the panel ribs and curb wall. Keep in mind that very wide curbs may require even more clearance on both the upslope end and the sides. (Figure 6)



Figure 6: This curb has 12” of clearance between the panel ends and the water diverter, which prevents water buildup.

Depending on the design requirements, a curb may be a 1 or 2-piece unit (Figure 7), or a multi-piece unit with or without a separate, structural framework. Two-piece curbs are generally used in retrofit applications where existing penetrations, such as chimneys or roof mounted equipment cannot be removed and must be flashed around to provide a weathertight condition. Rooftop units that exceed the maximum weight requirements for single curbs will require a structural curb surrounded by a one or two-piece flashing curb attached to the roof system. Framing for this structural curb is not considered part of the roof system.

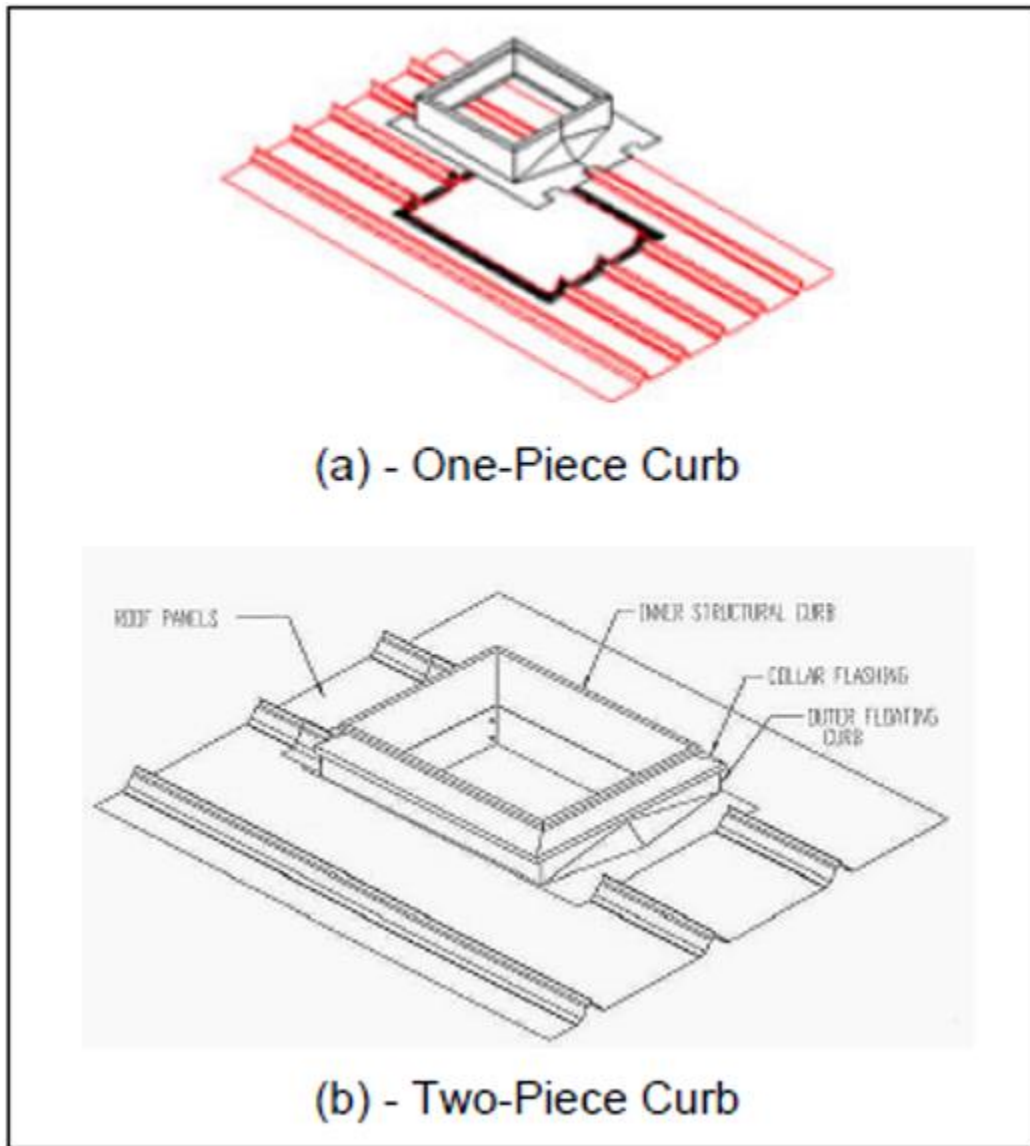


Figure 7: One-Piece and Two-Piece Curb Design

Double Curbs

In some situations, a structural curb may be required to support large, heavy roof equipment. These types of curbs are integral to the building's structural framing system. When such a design is employed, a second flashing curb is used for waterproofing reasons. There may be weight considerations as well. Heavy equipment on these types of curbs can sometimes be accommodated if they are located near the roof's point of fixity where movement is minimal. For these types of curbs, the installation details that seal the panels to curb flanges are similar details to those used to seal roof panels at the eave end. Installation involves tape and/or tube-grade butyl polymer concealed within the joints and metal closure components depending on the panel's rib geometry. All details are designed to be hydrostatic for low slope roofing. Panel ribs are terminated well upslope of the curb for easy drainage to the sides of the curb and curb-flange. Dimensioning should anticipate providing adequate drainage of diverted water. The concept is that the first curb, or frame, supports the weight of the unit and the second curb enables the waterproofing and integrates into the roof system. In this case, there is differential movement between the two curbs, so the outer flashing curb is larger than the first structural curb and a counter flashing of metal or flexible membrane joins the two, shedding water over the outer curb. The amount of differential movement increases with the distance of the curb from the fixed point of the roof panel. The outer curb is of the same design and material as previously described. Again, that curb need not be of such a heavy gauge because it does not support any additional weight. Installation details of the outer (flashing) curb connection to the roof also are the same as previously described with hydrostatic seals. Because there is differential movement between a structural curb and flashing curb, the joining of the counter flashing is sometimes accomplished with hydrokinetic, or water-shedding, details. This is acceptable because the joint is sufficiently above the drainage plane of the roof. Alternatively, hydrostatic detailing can also be performed when flexible membrane flashings are used.

Other Types of Curbs

Roof curbs may also be divided into two groups based on their installed location. Some curbs are **Exact Location** curbs, while others are **Field Located** curbs.

Exact location curbs are customized to fit at an exact location on the roof system. Because the curb must be located in an "exact" location, the roof installer will have to carefully plan roof panel layouts. The roof installer will coordinate the installation with the other trades involved to ensure that the penetrations have been properly located and sized to fit the curbs. This customized type of curb requires additional lead times, precise coordination of the trades, and may increase the initial cost.

Field Located curbs are designed and manufactured without the need for locating the exact curb location prior to panel installation. This type of curb is more common, especially since it has the benefits of shorter lead times and lower cost, but may not be suitable in every situation.

Rib-to-Rib curbs have sides that extend to the next panel rib. (Figure 8) This allows the curb to seal to the roof panels on each side "in the high," away from the water rather than down in the drainage plane of the panel. It also eliminates the problem of transitioning from under the roof on the upslope end to over the roof on the downslope end. This type of curb can be installed during or following roof installation.

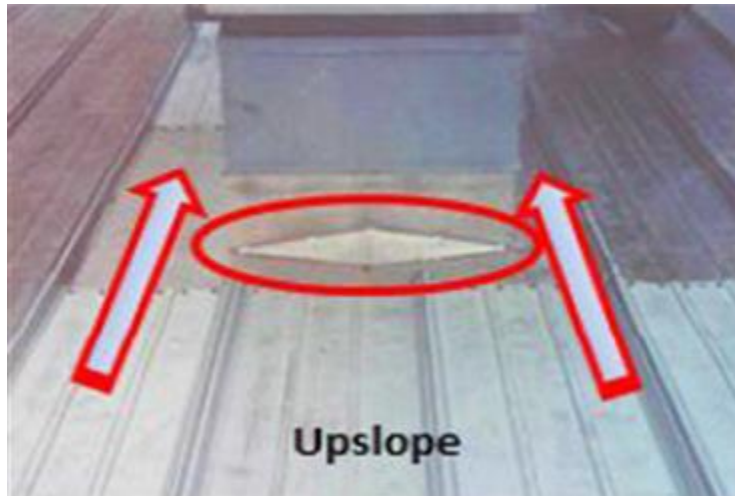


Figure 8: Rib-to-Rib Curb

Improper Installation

A common mistake is designing an insufficient flange on the upslope end of the curb. It is important to allow sufficient clearance between the ends of the panels and the beginning of the curb diverter. (Figure 9)



Figure 9: Curb with inadequate clearance on the upslope end allows a water head to build up

Many curbs also have inadequate clearance along the sides, which can cause water to build up at the upslope end of the curb. This buildup creates head pressure that will allow water into the building through any pinholes in the seal between the curb and the roof panels. (Figure 10) A well-designed curb will have a minimum clearance of 12” between the panel ends and the point of the curb diverter at the upslope end. The sides will have a minimum clearance of 6” between the panel ribs and curb wall. Very wide curbs may require even more clearance on both the upslope end and the sides



Figure 10: This curb does not allow for adequate water drainage

Summary

There are several factors an installer should consider in order to provide the best possible curb installation. The following are suggestions for a weather-tight and long-lasting curb installation: An installer should:

- Use curbs made from .080” aluminum or 18-gauge stainless steel. Galvanized and Galvalume® curbs do not offer the long-term performance of aluminum or stainless due to the vulnerability of the welds.
- Use curb details as recommended by the roofing manufacturer. Failure to do so could void manufacturer’s weather-tightness warranties.
- Use “over/under” shingled curb configuration
- Use the following clearances:
 - Minimum 12” between panel end and diverter on the upslope
 - Minimum 6” between the curb sides and panel seams
- Use rib-to-rib curbs
- Never use blocking made of dissimilar materials, such as treated lumber, in conjunction with any curb.

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