Metal Edge Flashing

Flat and low-slope roofs checker the landscape of every community. You see them on gas stations, movie theatres, shopping malls and schools. These roofs are normally finished with a metal edge to protect the ends of the roof and the top of the wall from wind and water penetration. This edge, commonly known as metal edge flashing, also serves to dress up the line of the roof and give it a clean appearance. A Factory Mutual Research Corporation study determined that 79 percent of the flat roof failures occurred at the edge.

Why is Metal Edge Flashing Important?

Metal edge flashing protects the edges of the roof and wall systems from wind uplift and water penetration. After the wind causes the flashing to fail, it then can get underneath the roofing covering, causing it to peel off completely. This allows rain to enter through the exposed area, causing major water damage to the interior of the building. Continual poor performance of metal edge flashing in strong winds results in costly, and sometimes catastrophic, losses.

Two conditions cause the fascia to bend: the failure of the fascia's lower restraint and the lack of bending resistance in the flashing material.

Sure, you know that hurricanes and tornadoes are obvious threats to metal edge flashing, but it is also vulnerable to the much lower wind speeds associated with thunderstorms, winter storms or just very windy days. In fact, all damage pictured in this report resulted from winds below hurricane strength.

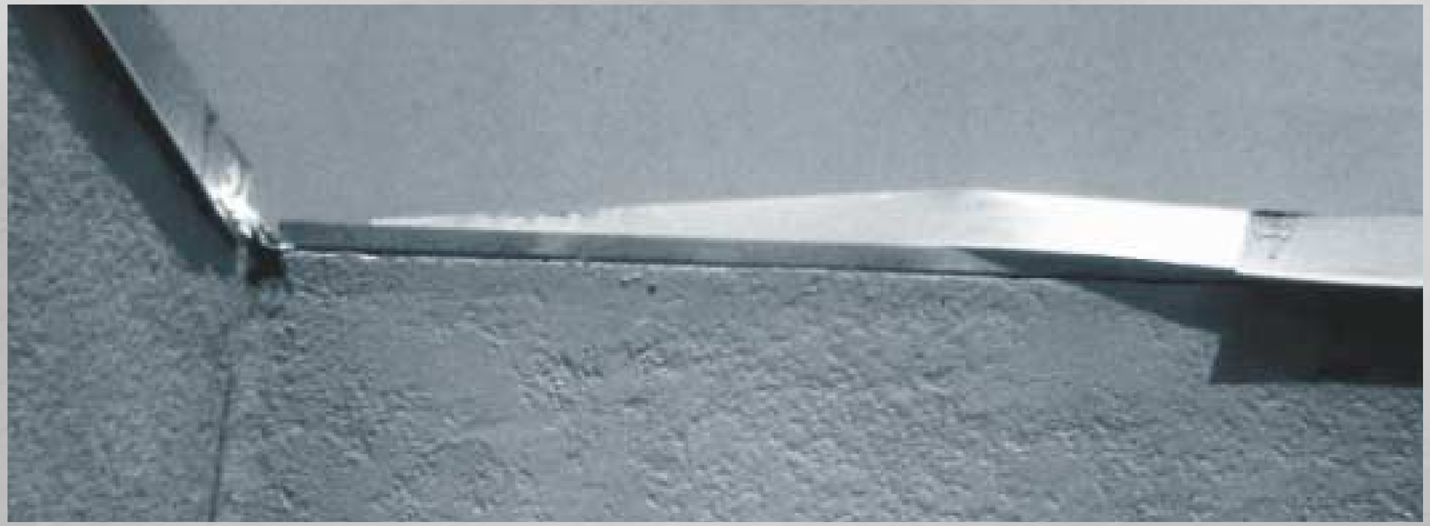
How Does Wind Affect Metal Edge Flashing?

History has repeatedly shown us the primary ways that metal edge flashing fails. Here are some of the most commonly observed failure modes:

Bending of Fascia

Metal edge flashing failure usually begins with the fascia. Outward wind pressures cause it to pull away from the building and bend upward. Once the fascia is bent like this, the wind has a lot more surface area to push and pull up on, causing the entire assembly to peel away from the building. At this point, it can pull the roof covering with it or it can tear off of the building entirely, becoming a wind-borne missile.

Two conditions cause the fascia to bend: the failure of the fascia's lower restraint and the lack of bending resistance in the flashing material. Metal edge flashing systems are frequently designed with a hook strip, or cleat, which holds down the bottom of the fascia. If this is missing or inadequate, the flashing material itself must resist the outward and upward pressures. This material is generally too thin to resist these loads and, subsequently, the flashing system bends upward and eventually peels back.



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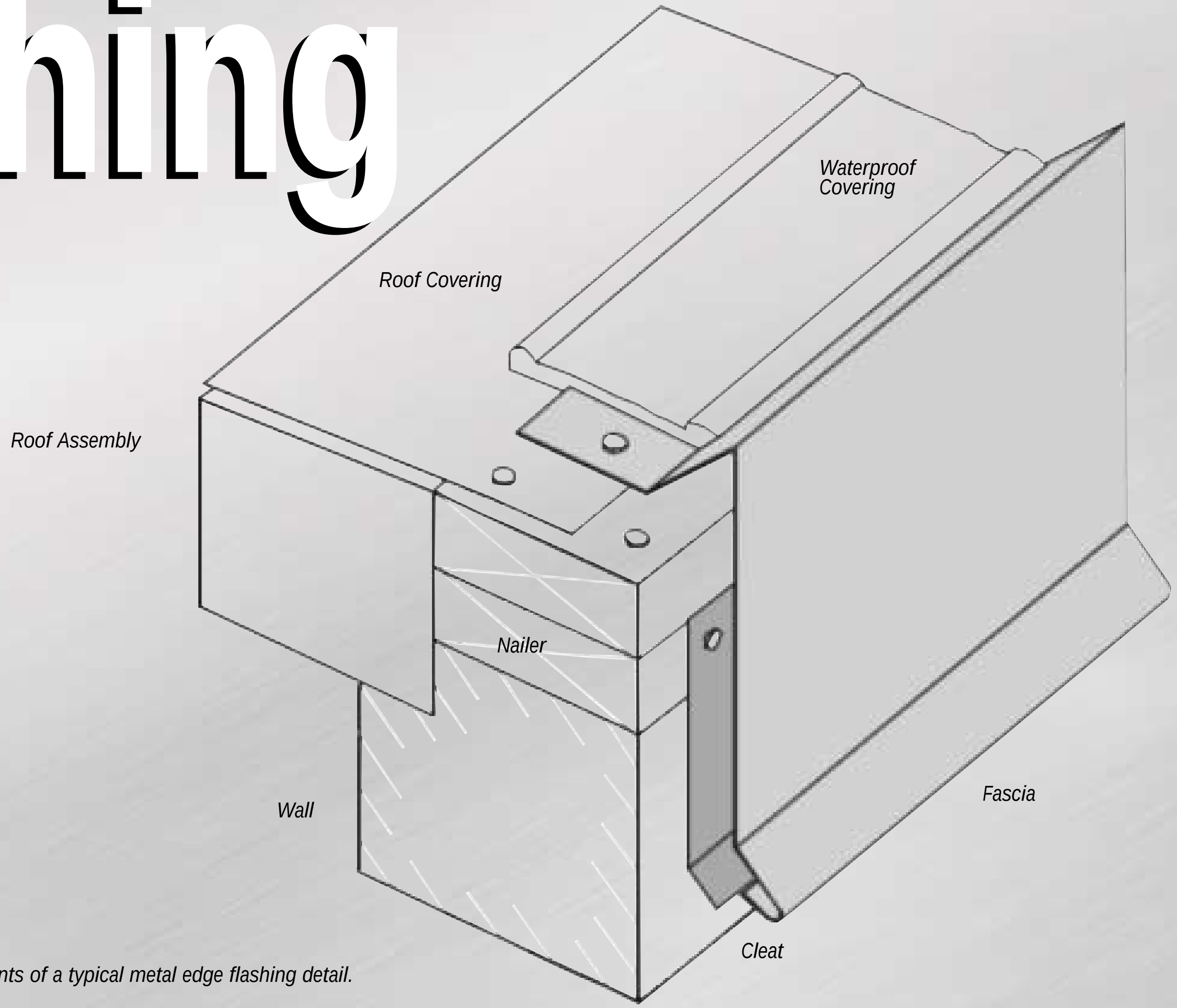

Components of a typical metal edge flashing detail.

To prevent this mode of failure, the fascia must not be allowed to bend upward. Improving the fascia's bottom restraint and stiffening the flashing material will add resistance to upward bending in high winds.

Nailing Substrate Failure

Nailing substrates, or nailers, provide a means for connecting metal edge flashing to the building structure. As shown in the illustration, typical nailers consist of two pieces of lumber. Anchor bolts hold the lower piece to the wall or roof framing system. Nails then hold the upper piece in place. Under design of the anchor bolts or nails between layers can cause the entire assembly to lift out of place, allowing wind and water to make their way underneath the roof covering and inside the walls.

All nailers, even those adequately designed for uplift loads, are vulnerable to deterioration over time. Water penetration can cause the wood to rot and fasteners to rust, diminishing the capacity of the connection of the flashing to the nailer as well as anchorage of the nailer back to the structure.

To prevent failure in this manner, decay-resistant lumber should be used for nailers, and all connections should be designed to resist corrosion and the wind uplift pressure applied to the flashing.

Other Concerns for Metal Edge Flashing

Gutters on low-slope roof buildings connect directly to the flashing system. This means that the system has to resist the wind pressures acting on the gutters in addition to the pressures acting directly on the flashing. This extra burden can lead to bending and peeling of the flashing or failure of the nailer.

Many roofs use gravel ballast to hold the roof covering in place. A windstorm can scour the roof, pushing ballast around and leaving portions of the roof covering unprotected. When the ballast is no longer holding the roof covering down, the flashing system has to do the job alone. This increased demand can cause the entire flashing system to be ripped off the building.

These conditions are not necessarily addressed when the metal edge flashing system is specified. Design standards and specifications must take into account these issues to ensure adequate performance of metal edge flashing systems.

How Does the Design and Construction Process Contribute to the Problem?

Architects and engineers design structural components like beams, columns and foundations to resist the maximum reasonable loads expected over the life of the building. On the other hand, building envelope materials like roof coverings, windows, doors and metal edge flashing are not considered structural components and receive little design attention. Instead, architects and engineers specify details and materials from a standard list of options — similar to the way you would select options for a new car.

Specification of Metal Edge Flashing

The standard list of options comes in the form of published guides like the Sheet Metal and Air Conditioning Contractors National Association's (SMACNA) Architectural Sheet Metal Manual. While such guides are easily referenced and widely used, they do not contain details specifically designed and proven to resist wind loads.

The Single-Ply Roofing Institute (SPRI) has developed a new design guide and test standard. The American National Standards Institute (ANSI) recognized this as a national standard and designated it ANSI/SPRI ES-1-98 "Wind Design Standard for Edge Systems Used with Low-Slope Roofing Systems." This standard clearly defines design loads and testing methods and represents a giant step forward. However, it does not provide examples of systems that resist given loads and there is no requirement for architects and engineers to use any standard to design and test edge systems before specifying them.

Installation of Metal Edge Flashing

In reality, the metal edge flashing specifications provided to roofing contractors can run the gamut from the very specific to the very general. Detailed specifications give contractors step-by-step instructions to follow when they fabricate and install the edge system in the field. This process can then be monitored to ensure proper completion of all steps and the system should perform as designed. When fewer details are provided, the contractor uses judgment and past experience to fill in the gaps. This leads to more uncertainty in what actually gets built and how it will perform.

Education is a critical component in addressing design, specification and construction issues of metal edge flashing.

It's just like the radio in your new car — if you don't tell the dealer which one you want, he/she will decide for you. Maybe you'll get the radio you want or one that's even better than you expect. On the other hand, you may not. Either way, you won't find out until you use the radio.

Another Option: Manufactured Edge Details

Another option for architects and engineers is to specify prefabricated metal edge products. These products are priced competitively to contractor-built systems and offer simplified installation methods. In addition, manufacturers of these products currently design and test them in accordance with ANSI/SPRI ES-1-98.

However, architects and engineers rarely specify manufactured edge details because they are unfamiliar with these products, which represent only a tiny fraction of the market. Roofing contractors also hesitate to use these products because the materials need to be ordered in advance and this complicates the scheduling process.

What Can Be Done?

Poor performance of metal edge flashing is by no means a new issue for the roofing and insurance industries. Many efforts have been made to address this issue, some in the recent past and some ongoing.

Full-Scale Pressure Measurement Tests at TTU

Texas Tech University (TTU) conducted full-scale pressure tests on several different flashing details to determine design wind pressures for roof edge flashing. The study suggests that the pressure coefficients in the American Society of Civil Engineers' "Minimum Design Loads for Buildings and Other Structures" (ASCE 7) underestimate the actual wind uplift force on metal edge flashing. The researchers recognize the limited scope of this initial study and recommend further research before proposing changes to ASCE 7. These concerns extend to ANSI/SPRI ES-1-98 as well, which bases its design pressures on ASCE 7.

The research also indicates that horizontal pressure coefficients depend on the size of the fascia. In general, pressure coefficients increased as the fascia width decreased. TTU recommends additional research into this phenomenon and its impact on design loads for flashing systems.

ANSI/SPRI Design Standard and Test Method

ANSI/SPRI ES-1-98 provides an abbreviated method for using ASCE 7 to determine design pressures for edge flashing systems. One major difference between the two standards is that ASCE 7 calls for increased pressure coefficients in corner regions, while ES-1-98 simply requires twice the number of fasteners.

ES-1-98 is the first standard to require testing of metal edge flashing details to resist design loads.

While roof edge system manufacturers already test their products for compliance with these criteria, no contractor-fabricated metal edge flashing systems have been tested.

The ANSI/SPRI standard does not address inspection, testing or retrofitting of flashing already existing in the built environment. This standard should be reviewed and updated as ASCE 7 changes and more is learned about the behavior of metal edge flashing.

Generic Detail Testing

Testing of commonly used generic details with the SPRI/ANSI test methods is the next logical step in fixing the problem. This testing will provide architects, engineers, manufacturers and contractors with specific examples of what does and does not work. Such research will help make the standard more attractive and provide usable information for the roofing and insurance industries. In addition, the results will serve as a baseline for research into retrofit solutions for existing flashing systems.

Education

Education is a critical component in addressing design, specification and construction issues of metal edge flashing. A primary culprit is that the parties involved do not even realize there is a problem. Clear responsibilities for architects, engineers and contractors need to be defined so that no details go unattended. Education for building owners and their insurers is necessary so that they can understand the risks they are assuming. ▲

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Failure of nail attachment to masonry wall.

Bent and peeled flashing creates gaps for wind and water penetration

Bending and peeling of flashing takes the top layer of roof covering with it.