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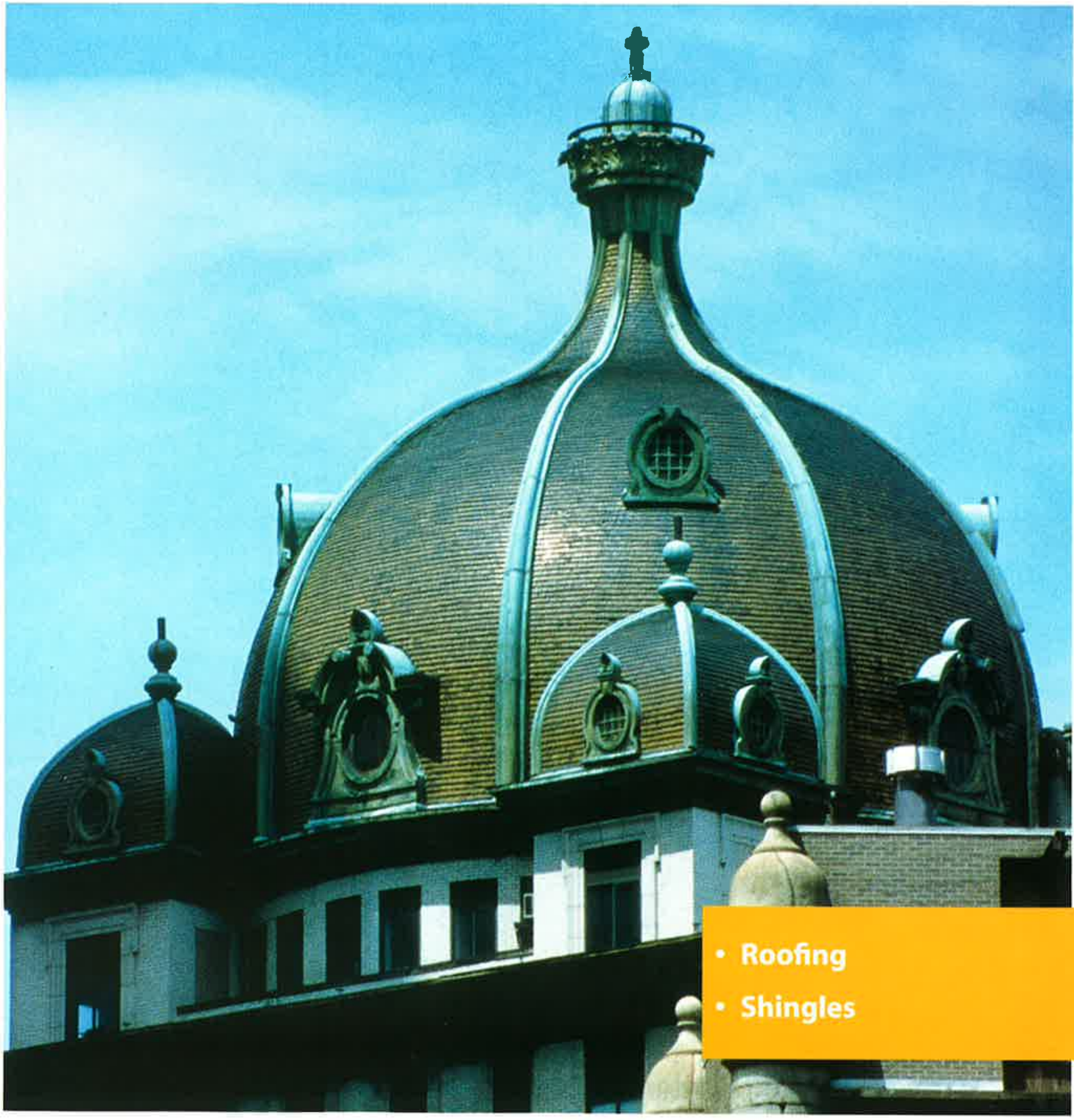

- Roofing
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Copper Flashings in Contemporary Construction

by Daniel Sternthal

Photo courtesy the author

Most modern construction materials are resistant to moisture penetration. However, many joints between masonry units, panels, roofing materials, and architectural features are not. The effects of natural movement due to settlement, expansion, and contraction tend to compound the problems and may eventually lead to leaks. Flashing is used to prevent moisture from entering at such locations. It is also used to divert to the exterior moisture that has already entered various components of a structure.

Moisture penetrating into a building may cause serious damage to its interior. In freezing temperatures, it can also cause severe damage to the exterior of the building. Cracking, spalling, and disintegration can result. Over a long period of time, moisture can also weaken structural elements.

ADDITIONAL INFORMATION

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Abstract

Copper is an excellent material for flashing because of its malleability, strength, and high resistance to the caustic effects of mortars and hostile environments. Flashing, in general, is expensive to replace if it fails. The long life copper flashing offers is a major asset in this application.

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General Requirements

Flashings and copings are fabricated from cold rolled copper in weights ranging between 455 g/m² and 567 g/m² (16 oz/ft² to 20 oz/ft²). The required weight depends on the application; copper is specified in ounce (oz) weight.

In general, cold rolled 1/8 hard temper (H00) copper is recommended for most flashing applications. Soft copper may be used where extreme forming is required such as in complicated roof shapes. However, it should be noted cold rolled copper offers far more resistance than does soft copper to the stresses induced by expansion and contraction.

Wood blocking must be provided for the attachment and support of copper copings, gravel stops, edge strips, roof sumps, scuppers, and other copper roof accessories.

Wherever sealant is used and comes into contact with copper, a rubber or synthetic-base sealant compatible to copper must be specified.

The Importance of Thermal Movement

Most important in proper flashing design is the correct matching of details and application in regard to thermal movement. Two fundamental methods exist to account for thermal movement: prevent movement and resist the cumulative stresses within the copper, or allow movement at predetermined locations to relieve thermal stresses.

It is desirable to prevent movement in applications such as gravel stops, edge strips, base flashing at builtup roofing, and flashings around doors and windows. These applications involve narrow strips of copper flashing sometimes embedded in the roofing material. Movement in these cases could be detrimental to the overall system performance.

The copper flashing strips should be nailed frequently to effectively transfer stresses to the underlying substrate before causing buckling in the copper. Nails spaced at 76 mm (3 in.) on center in a staggered pattern are recommended.

In situations where movement is desirable, the use of cleats addresses two needs: a self-flashed hidden tie-down system locking the flashing to the substrate and a loose system allowing internal system movement. Cleats are substructural units designed to withstand wind uplift and gravity forces as well as allow for internal movement. Many copper flashing edge conditions are detailed with either continuous cleats or edge strips or with clip

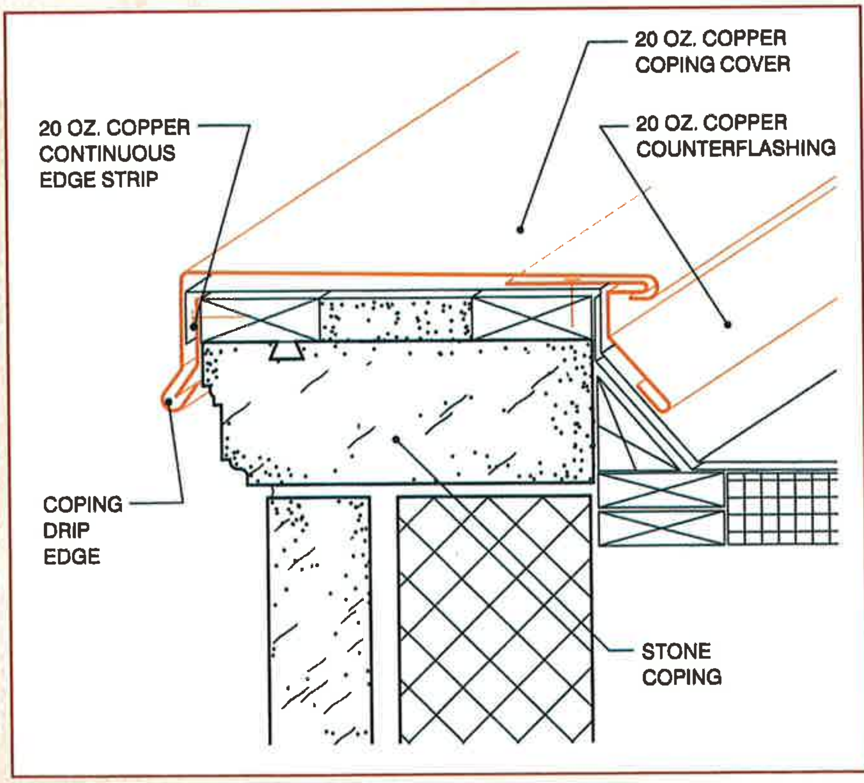

Figure A. Coping Cover. 4.3.8/A
This detail illustrates a copper cap flashing over a masonry wall. The continuous edge strip is nailed to the blocking and is restrained. Similarly, the roofside counterflashing is also nailed and restrained. The coping cover is loose locked around these two elements and allowed to expand and contract freely. Coping transverse seams are formed using a single loose lock or solder. Maximum recommended distance for loose-locked pan runs is 9.1 m to 10.7 m (30 ft to 35 ft) at which point an expansion seam detail is recommended.

strips spaced closely together at 305 mm to 406 mm (12 in. to 16 in.).

The flow of water must be planned for and not impeded. Flashing should typically have at least a 203 mm (8 in.) vertical drop from its upper to its lower edge. Where a sealant is used in conjunction with flashing, as at a shelf angle, it should be installed below the flashing so moisture diverted by the flashing will not be trapped by the sealant.

Corrosion Concerns

When dissimilar metals are in contact with one another in the presence of moisture, galvanic corrosion occurs. The lower galvanic number or the least noble leads to the deterioration of the metal. Copper is one of the noblest metals and will usually cause less noble metals such as aluminum, galvanized steel, or painted steel to corrode.

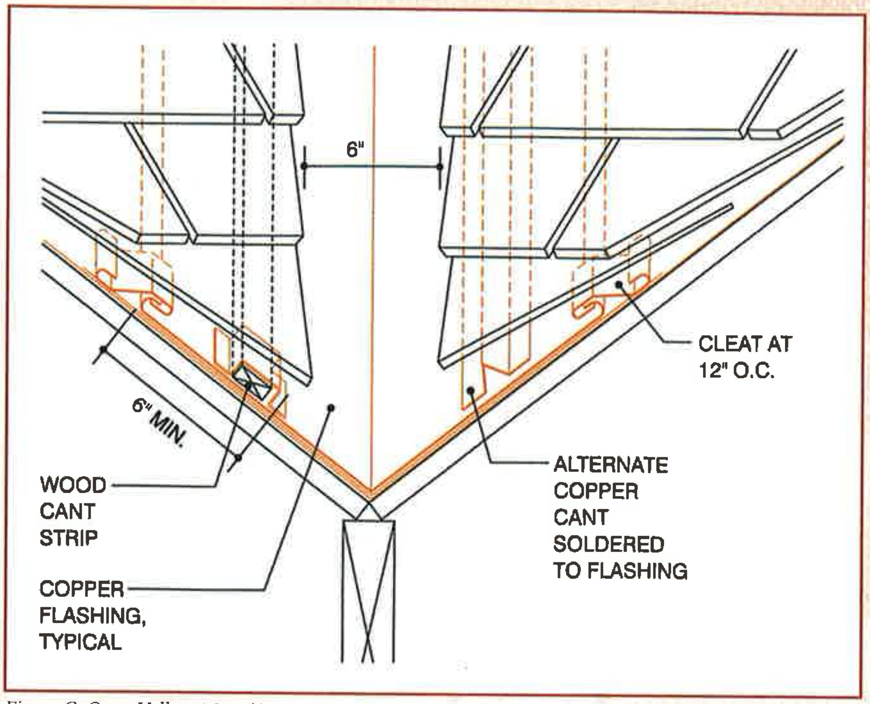

Figure C. Open Valley. 4.3.11/A
This detail shows an open valley flashing for a shingle application. Two different cants are illustrated. The cant strips are used to raise the leading edge of the shingle to break contact with the copper and prevent line corrosion.

Contact between copper and other metals should be avoided. Where this is not possible, such as at a structural support for mechanical equipment, some method of material separation is required. This condition is most often solved with the use of a bituminous coating applied to the metals to prevent direct contact.

The two most common types of corrosion to copper flashing are erosion corrosion and line corrosion.

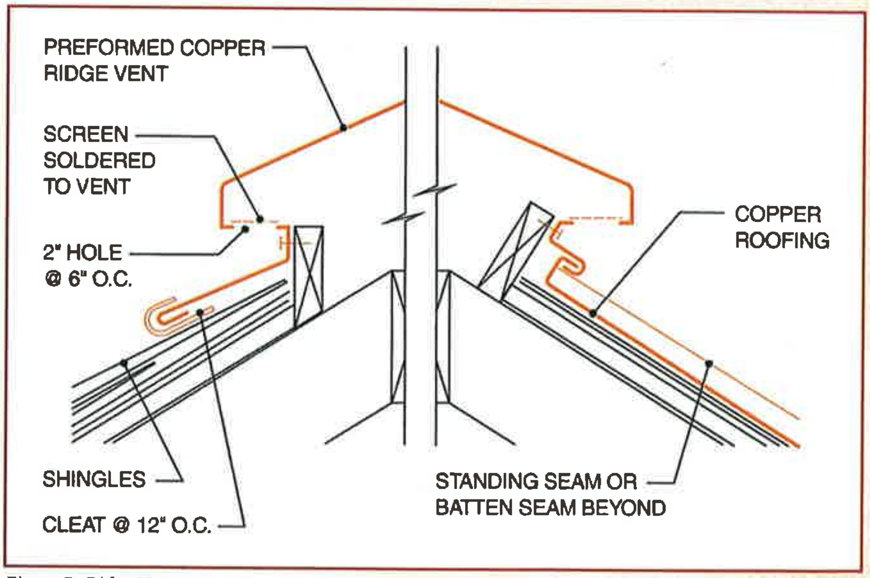

Figure B. Ridge Vent. 4.3.10/B
Two conditions are shown, a shingle roof on the left and a copper roof on the right. In each case, wood blocking frames the perimeter of the roof opening. The preformed copper ridge vent is nailed to the blocking at 76 mm (3 in.) o.c. and is formed from 567 g (20 oz.) copper. For the shingle roof, the lower edge of the vent acts as a counterflashing, is hemmed, and is held by exposed cleats at 305 mm (12 in.) o.c. For the copper roofing, the lower vent edge is locked into the upturned edge of the roofing pan in a breadpan detail. Movement of the system in this detail is minimized by the closely spaced vent nails.

Erosion corrosion is caused by the flow of acidic water concentrated on a small area of copper. This occurs when rain falls on a noncopper roof such as tile, slate, wood, or asphalt. The acidic water is not neutralized as it flows over the inert roofing material and is diverted or collected by a relatively small copper flashing or gutter. This may preclude the forming of the protective patina and may lead to early copper deterioration.

Line corrosion is due to incorrect shingle installation. The leading edge of shingles, if installed in direct contact with metal flashing, will wick water through capillary action under the leading shingle edge. The water tends to remain in contact with the flashing and build in acidity. This acid laden water will corrode flashing in a linear pattern following the shingle edge leading to line corrosion or pinholes in the flashing. The correct detail is to raise the leading shingle edge on a cant, thus breaking the bond between the shingle and flashing (see Figure C).

A note of caution: the installation downstream of noncopper elements such as

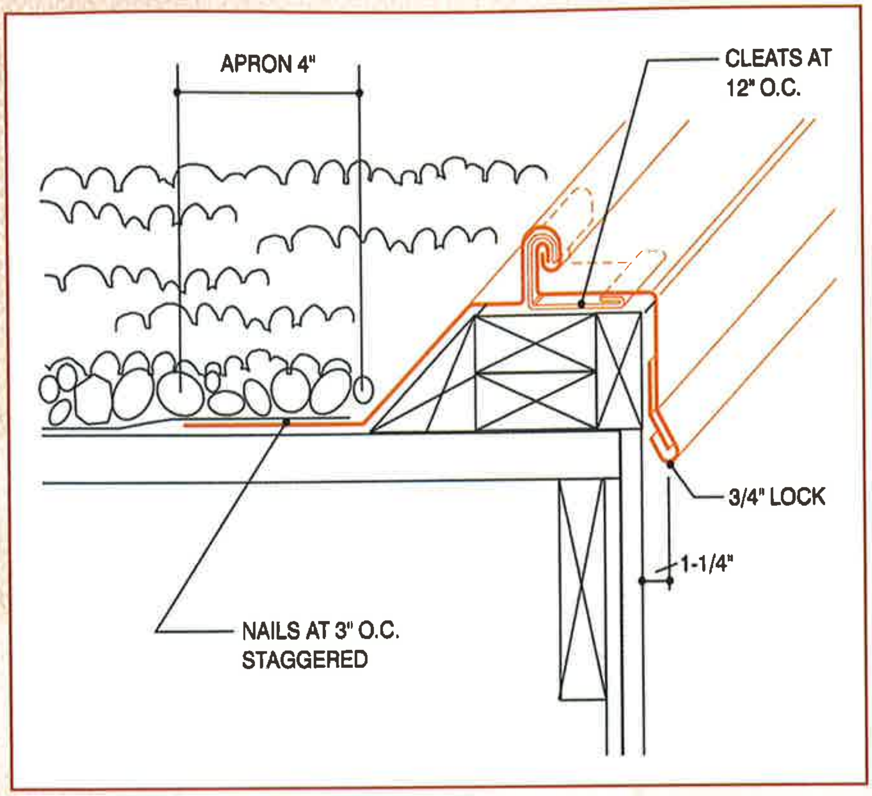

Figure D. Gravel Stop. 4.3.13/A
This figure shows a gravel stop installed on a wood curb but set back from the fascia face. There are two components to this detail: a gravel stop and a fascia joined on the curb by a double locked standing seam. The lower edge of the fascia locks into a continuous edge strip, and is formed into a drip with a 19 mm (3/4 in.) lock.

The copper roof apron is nailed to blocking at 3 in. o.c. in a staggered pattern. This detail allows the separation of two distinct flashing conditions with their respective expansion requirements. The apron is stripped in with the roof system and is required to have minimum movement. The fascia is loose locked and requires freedom of movement. The standing seam allows the separation of these two systems with their respective expansion requirements.

aluminum or galvanized steel gutters below a copper flashed roof should be avoided. The waterborne copper salts, if concentrated in a less noble gutter, could corrode the gutter system.

Solder and Sealants

Copper construction methods have traditionally relied on solder to ensure water tightness and to strengthen flashing joints and seams. The solder used is 50-50 tin-lead for uncoated copper and 60-40 tin-lead for lead coated copper. An alternative to solder where strength is not required is the use of sealants. However, a copper flashing system will far outlast most sealants and thus, their use within a copper flashing system is discouraged and should be limited.

Finishes

Contemporary research and manufacturing techniques have led to various copper finishes as follows: factory finish, lead coated, tin/zinc coated, oxidized, factory prepatinated, and field patinated.

In most cases, the installation of factory-finished copper leads to satisfactory performance. However, in cases where an alternative color or the matching of components in a restoration project is desired, a choice of copper flashing colors is available.

Where runoff of waterborne copper salts on to lighter building materials is a concern, lead or tin/zinc coated copper help

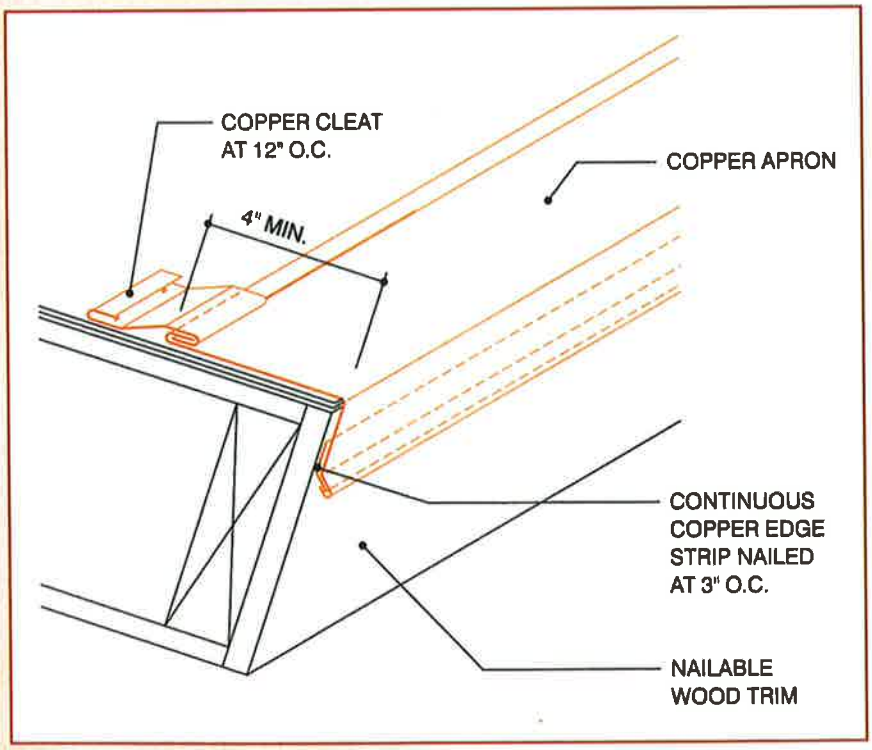

Figure E. Eave Flashing. 4.3.19/B
This detail is typically used for flashing shingle roof systems. The copper flashing is extended a minimum of 102 mm (4 in.) onto the roof to form an apron. The upper edge of the apron is folded and cleated at 305 mm o.c. or it may be nailed at 76 mm o.c. in a staggered pattern.

The apron depth should take into account local conditions such as wind, rain, snow, and potential ice buildup as well as roof slope. The lower edge of the flashing is bent around the eaves and is locked into a continuous edge strip formed into a 19 mm (3/4 in.) drip edge. This detail allows horizontal free movement of the flashing while providing for resistance to uplift wind forces.

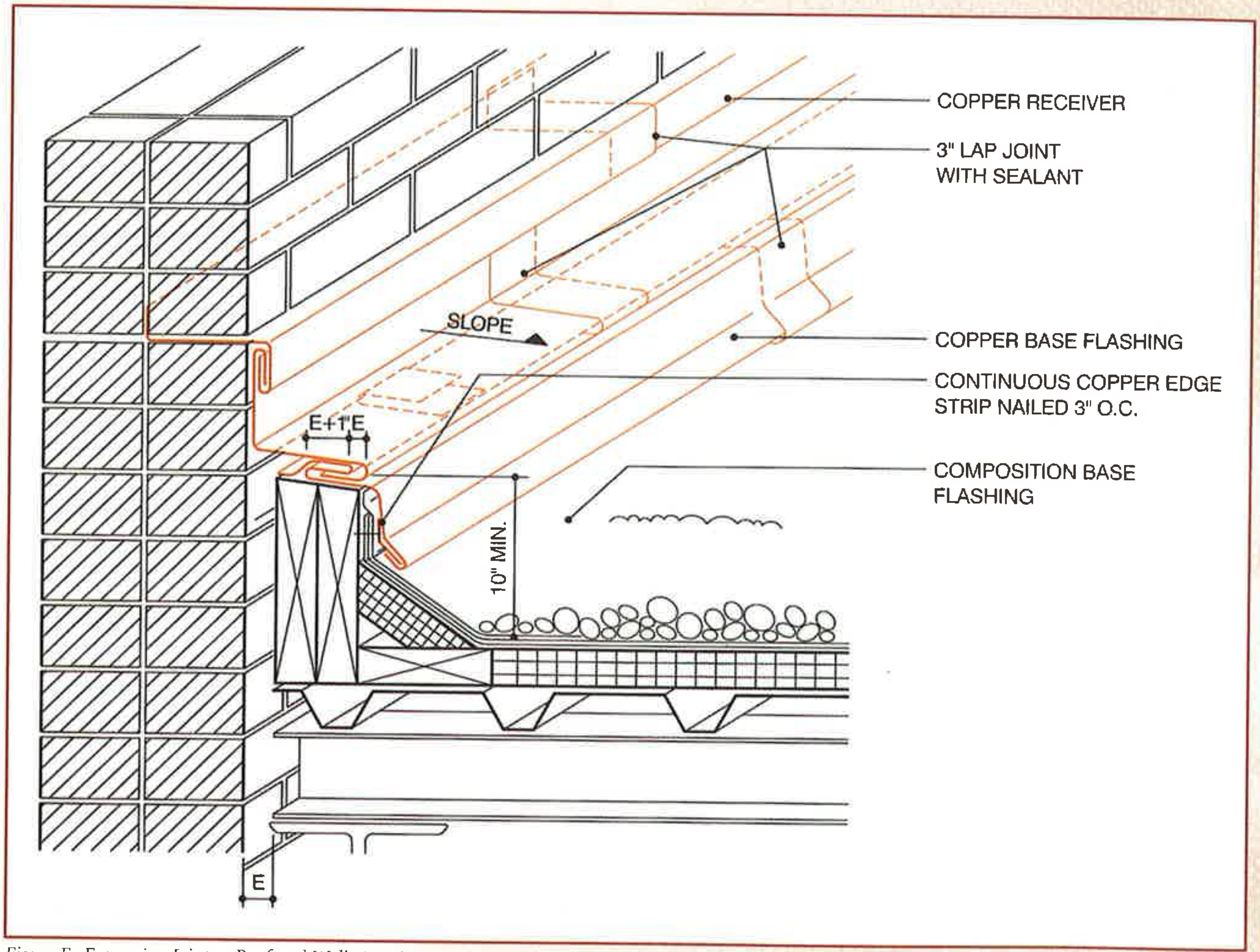

Figure F. Expansion Joint at Roof and Wall. 4.5.5/A

Copper base flashing is double-folded and nailed to the top surface of the curb which is cut to slope. Its lower edge is held by a continuous edge strip. Its upper edge is folded over, and long enough to accommodate maximum building movement. Copper counterflashing is folded into this edge. The upper edge of the counterflashing is held by a copper receiver which is set into the masonry joints. If the wall is an existing one, the mortar joint is raked to a depth of 25 mm (1 in.) and the copper receiver is inserted, wedged and sealed. This detail precludes any movement of the base flashing but allows for maximum movement at the counterflashing.

mitigate such problems. These coatings are not meant to extend the life of the flashing systems, but they are to be specified in situations where material color or runoff staining are an issue.

If rich brown tones are desired, the specification of oxidized copper should be considered. These finishes provide a factory finish that will patina naturally to the final patina color most common to the project location.

Prepatinated copper is available to allow the installation of copper with an inherent factory applied patina coating. Prepatinated coatings are chemical compounds of inorganic crystals fused to the base copper with the same permanent bonding as naturally formed patina. For projects requiring the matching of new flashing to old, field applied patina systems are available.

Longevity

Copper flashing offers beauty, low maintenance, and a long service life. In most cases, copper flashing does not need to be replaced when the roof is replaced, and it will outlast most other flashing materials. In coastal or highly polluted environments, copper naturally resists salt water or acid rain corrosion. The naturally formed patina is a self-protective coating formed on copper providing a tenacious barrier to corrosion. Copper is therefore a natural match and is well suited as a flashing material in high-performance long-lived roof systems.

Cost Effectiveness

The cost of building components, such as copper roofing, flashing, gutters, and downspouts, must be evaluated in the context of their use, performance, maintenance, and service life. Many applications of copper involve uses critical in maintaining the integrity of the building envelope. Copper performs these functions economically for a long time. There are many examples of copper roofs and flashing systems that have been in service for many decades—even centuries. In selecting flashing material, the initial material cost may be insignificant compared to the cost of repair or replacement if the flashing fails. Copper components typically offer extremely low maintenance and long life, even in coastal and industrial environments, making it an economical material for use in these and many other applications.

When life cycle costs are evaluated, these factors should be quantified. Initial costs, maintenance costs, and the life expectancy of the systems must be estimated, as should the salvage value of the material. Copper is an inherently recyclable material retaining much of its primary metal cost. This is far greater than competing materials whose scrap values range from about 60 percent down to nothing. The results make copper an outstanding material in terms of life cycle costs.

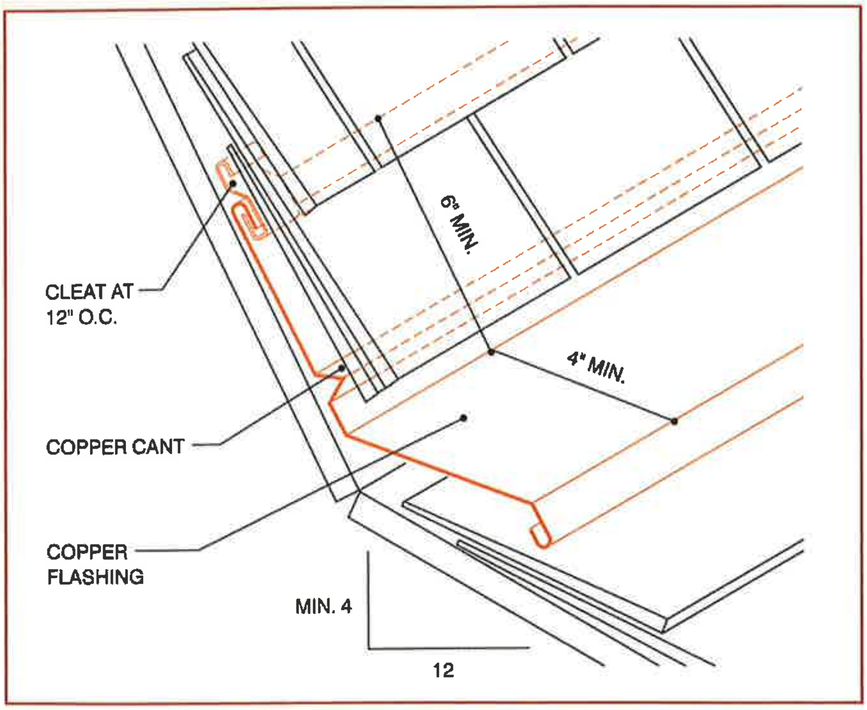

Figure G. Change of Roof Slope. 4.3.12/B The copper flashing extends under the copper roofing a minimum of 152 mm (6 in.). It laps the lower roofing a minimum of 102 mm (4 in.). The transverse ends of each flashing section should lap over the preceding one at least 102 mm (4 in.). The lower edge of the flashing is hemmed for stiffness. Under high wind conditions and for low slope roofs subject to snow and ice, a continuous lock strip is installed at the leading edge of the flashing and locked into the hemmed edge.

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