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D-01-19

Wood Nailers and Securement Criteria (Factory Mutual Loss Prevention Data Sheet 1-49)

October 2019

The information contained in this supplement serves as a criteria for Specifiers and Authorized Applicators regarding the design and installation of Carlisle Roof Foam and Coatings (CRFC) roofing systems and related products. Additional information essential for the design and installation of the Roof Systems are also included in the respective Specification for each Roof System and in the Design Reference Section of as well as the applicable Spec Supplement.

One of the most often overlooked details on a roofing system is the attachment method for wood nailers at the perimeter of the roof. Factory Mutual Global (FMG) publishes design recommendations for the attachment of wood nailers to various substrates and for the attachment of perimeter flashing details to wood nailers. This information is contained in Factory Mutual's Property Loss Prevention Data Sheet 1-49. In accordance with that Data Sheet, the information listed below should be referenced when selecting an appropriate perimeter attachment method.

General Criteria

A **horizontal wood nailer** is used to provide an effective substrate for some installation details and for other roof accessories. In addition, it is used to provide solid protection for the edge of the roof assembly. Minimum thickness of the nailer must be thick enough that the top of the nailer is flush with the top of the roof assembly.

1. The width of the nailers must exceed the width of the metal flange of edgings, scuppers, etc.
2. When treated lumber is specified, it is recommended that only lumber that has been pressure treated with salt preservatives be specified. Lumber treated with any of the wood preservatives such as, Creosote, Pentachlorophenol, Copper Naphthenate and Copper 8-quinolinolate will adversely affect the spray foam and coating when in direct contact and are, therefore, **unacceptable**.

If non-treated lumber is to be specified, it must be stored to protect from moisture sources. A seal should be provided between the non-treated lumber and a concrete or gypsum substrate (similar to a sill sealer).

3. Methods used to fasten the nailer vary with building conditions; however, it is essential that secure attachment of durable stock be accomplished. Factory Mutual Loss Prevention Data Bulletin 1-49 (Perimeter Flashing) contains options for the spacing and sizing of fasteners based on the project wind zone.
 4. Wood nailers are not covered by the Carlisle warranty.
- Wood nailers that are anchored to steel, wood or masonry decking should not be less than 2" X 6" nominal (minimum 1-1/2" X 5-1/2").
 - Wood nailers should be Douglas Fir, Southern Yellow Pine or of wood having similar decay resistant properties.

Attachment to Masonry Walls

When fastening to a masonry wall, a 1/2 inch diameter anchor bolt is placed 48 inches on center at an 8 inch minimum depth (12 inches minimum when masonry walls are composed of lightweight aggregate or cinder) as shown in **Figure 1**. Each anchor bolt is positioned (staggered if the wood nailer is wider than 6 inches) in a block core or air space and tightly filled with concrete to the depth of the bolt.

Note: Plastic parts must not be used with masonry anchors.

FMG has specific requirements concerning filling of cores or voids in the top course of cinder blocks.

For example:

Projects requiring 75-psf or 90-psf ratings - fill the entire top course.

Projects requiring 60-psf ratings - fill only required where anchor bolts are positioned (48 inches on center in the field, 24 inches on center at roof corners).

At outside corners, the fastening density must be increased within the first 8 feet in each direction by positioning anchor bolts 24 inches on center.

An alternate method may be used by installing 3/8 inch diameter anchor bolts spaced 32 inches apart. For outside corners, bolts are fastened 16 inches apart, 8 feet from each side of the corner. If additional wood nailers are needed, refer to **Figure 5** for attachment of additional wood nailers.

Attachment to Steel and Wood Decking

- Penetration of the fasteners should be to the top flutes only. The fasteners must be staggered as shown in **Figure 2**. Consult the Steel Deck Institute for separation requirement if treated nailers are used.
- The staggered fastening pattern should be increased within 8 feet from outside corners as shown in **Figure 3A**.
- If the perimeter nailer is to be secured to a steel angle, anchor bolts must be positioned at 48 inch centers as show in **Figure 4**.
- On wood decks, the staggered fastening pattern with galvanized steel screws should be utilized as shown in **Figure 2**.

Caution: Attention should be paid to the FMG requirement which calls for galvanized steel washers (minimum 5/8 inch outside diameter) to be used in conjunction with galvanized screws. This requirement is not recognized in most cases and most often forgotten.

Attachment of Additional Wood Nailers

- When additional wood nailers are required, they must be attached with galvanized nails or lag screws that penetrate into the bottom nailer at 1-1/4 inches using a staggered fastening pattern in two rows at 24 inches apart as shown in **Figure 5**.
- The increased fastening density within 8 feet from outside corners is still required and must comply with **Figure 3**.
- The Data Sheet also contains important information pertaining to attachment of metal fascia/edging especially for those edgings which are shop fabricated.
- Even though not emphasized in the Data Sheet, contractors should examine or question existing conditions to determine if existing wood nailers are attached in compliance with the above criteria. If not, existing wood nailers should be refastened using one of these options and additional wood nailers must be secured following **Figure 5**.

Projects where Factory Mutual is the insurance underwriter should be reviewed by the local Factory Mutual office for specific criteria.

Since wood nailers are not considered part of the Carlisle Foam and Coating System Warranty, they are not addressed in depth in the Carlisle specifications nor inspected by the Carlisle Field Service Representative. Wood nailers, however, play a major role in the performance of the roofing system and contribute to the wind uplift resistance of the roof edge which is the first line of defense during wind storms.

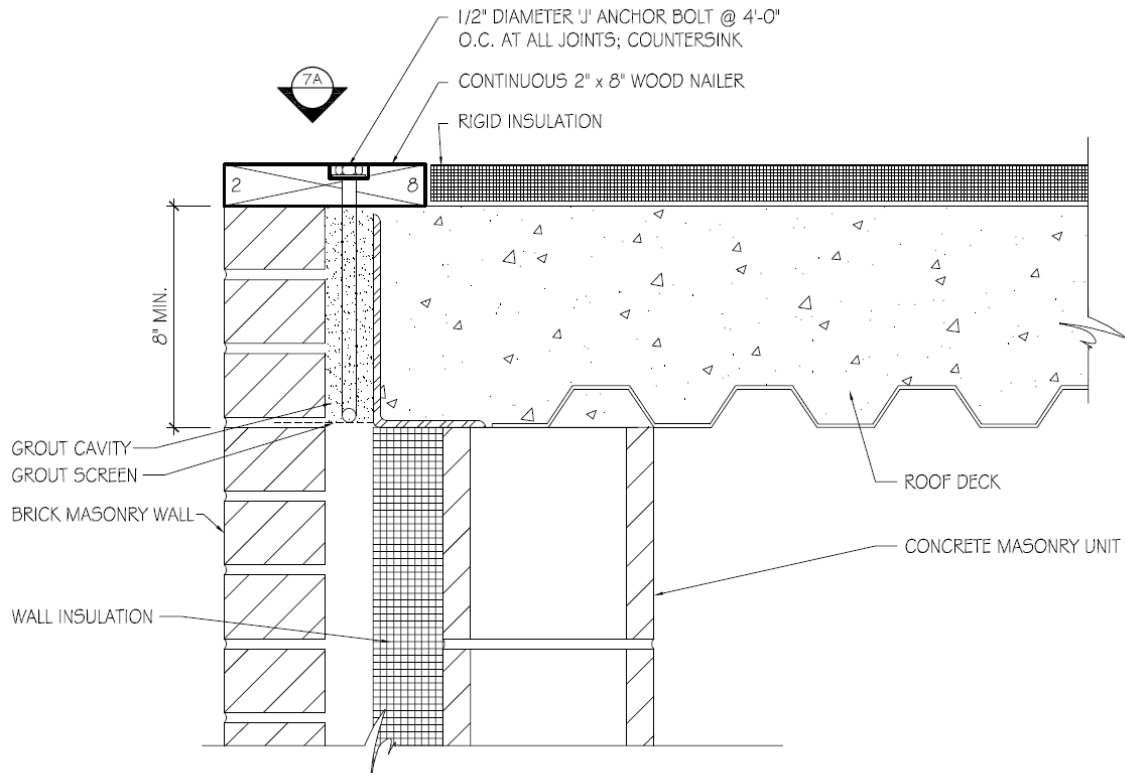


FIGURE 1 - ROOF EDGE WOOD BLOCKING - ANCHOR BOLT SECUREMENT

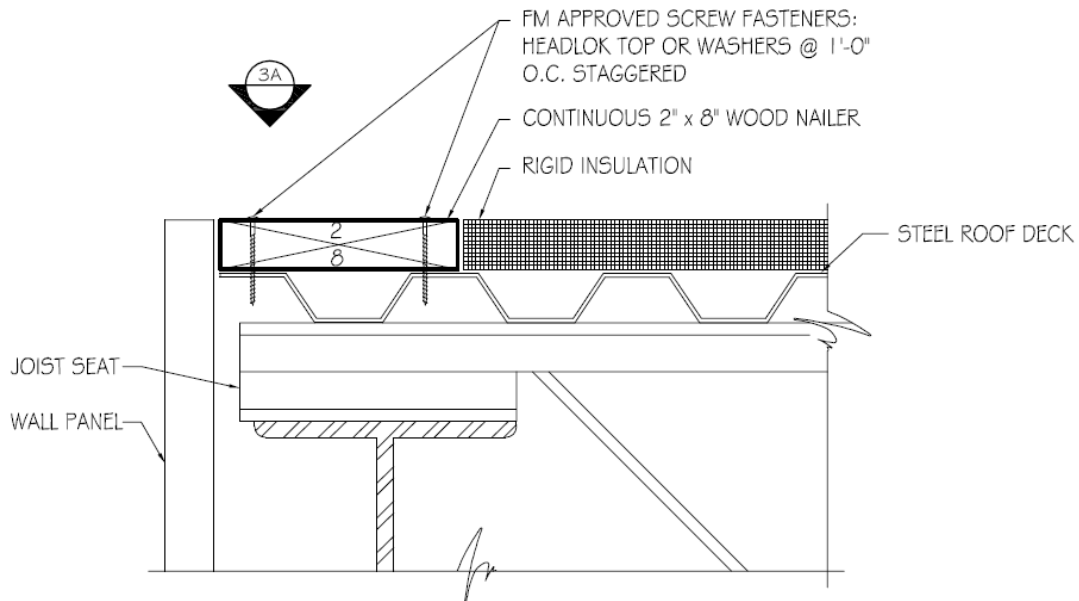


FIGURE 2 - ROOF EDGE WOOD BLOCKING - SCREW FASTENER ANCHORAGE

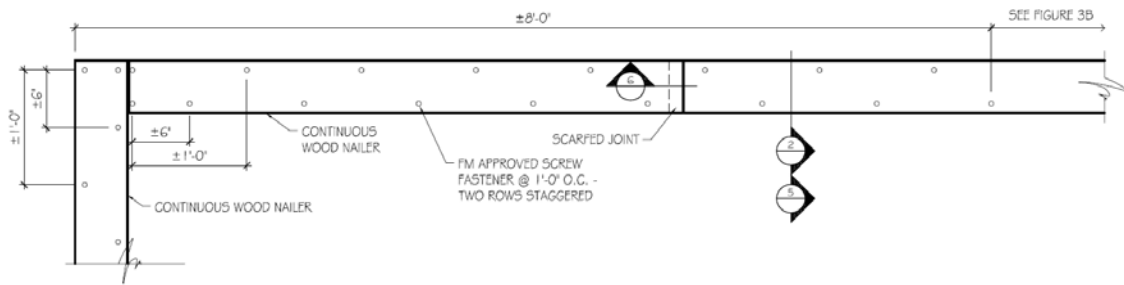


FIGURE 3A - WOOD BLOCKING CORNER ANCHORAGE 8'-0" FROM CORNER

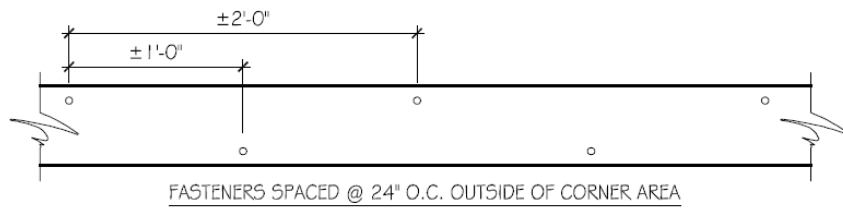


FIGURE 3B - TYPICAL ROOF EDGE WOOD BLOCKING - SCREW FASTENER ANCHORAGE

1/12" = 1'-0"

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NOTES:

1. AT 8'-0" CORNERS, FASTENERS DOUBLED (12" O.C. IN EACH ROW).

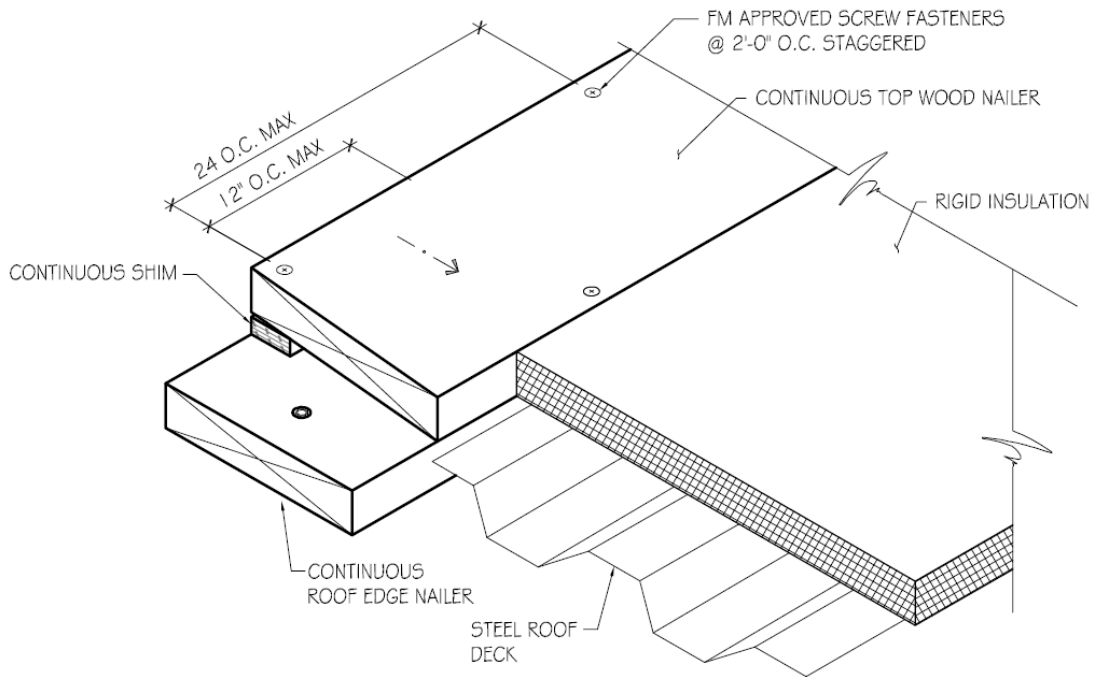


FIGURE 5

STEEL WOOD DECK SCREW FASTENERS AS FOLLOWS:

- 2 x 4 - 2 SCREW FASTENERS
- 2 x 6 - 3 SCREW FASTENERS
- 2 x 8 - 4 SCREW FASTENERS

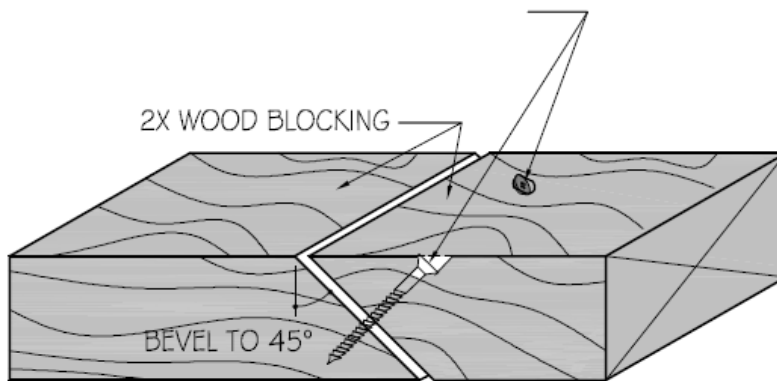


FIGURE 6 - MITERED WOOD JOINT DETAIL

NOTES:

1. 3/4" Ø ANCHOR BOLTS @ 48" O.C.
2. AT 8'-0" CORNERS: FASTENING DOUBLED (24" O.C. MAX)

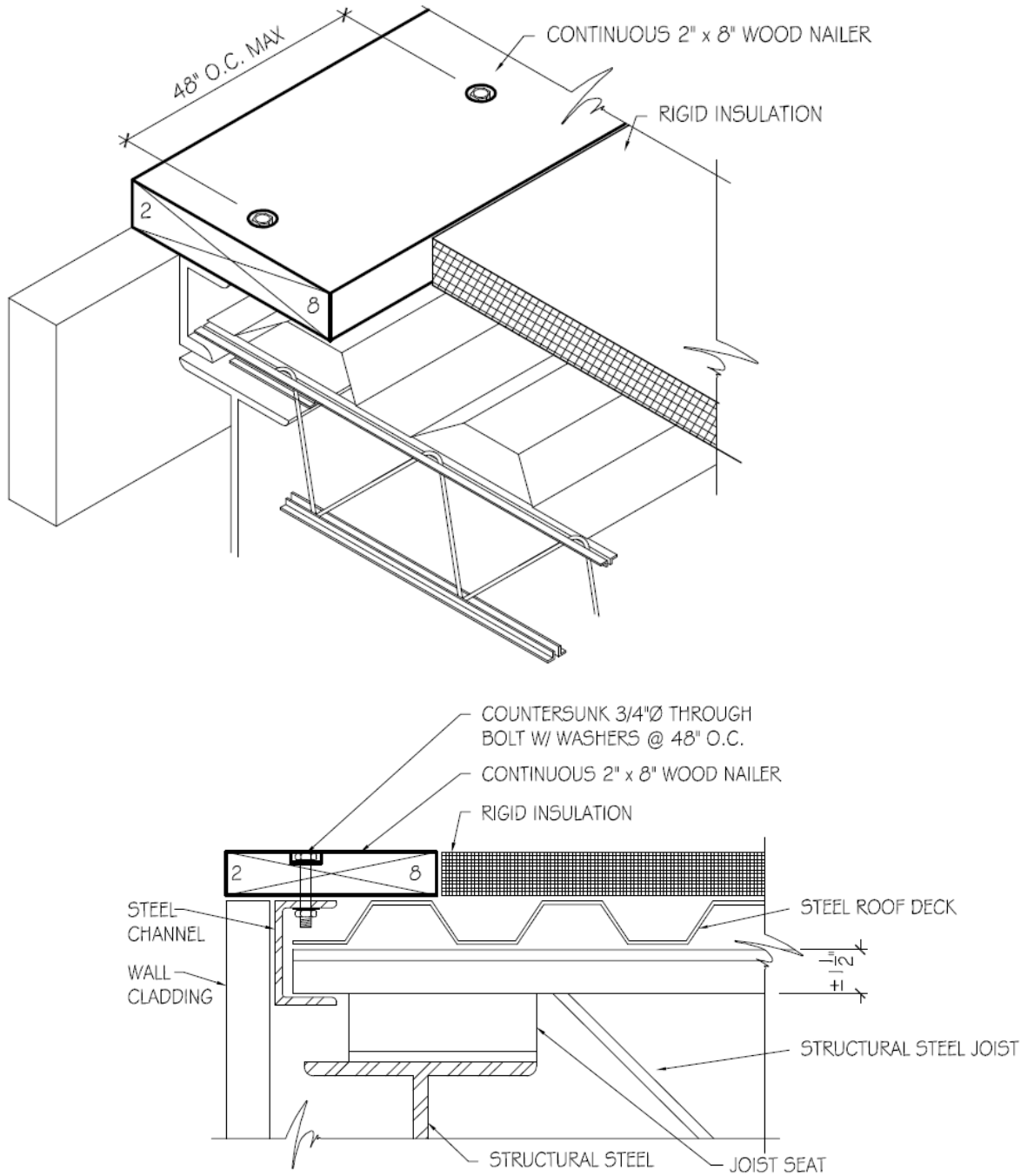


FIGURE 4 - ROOF EDGE WOOD BLOCKING - THROUGH BOLT ANCHORS

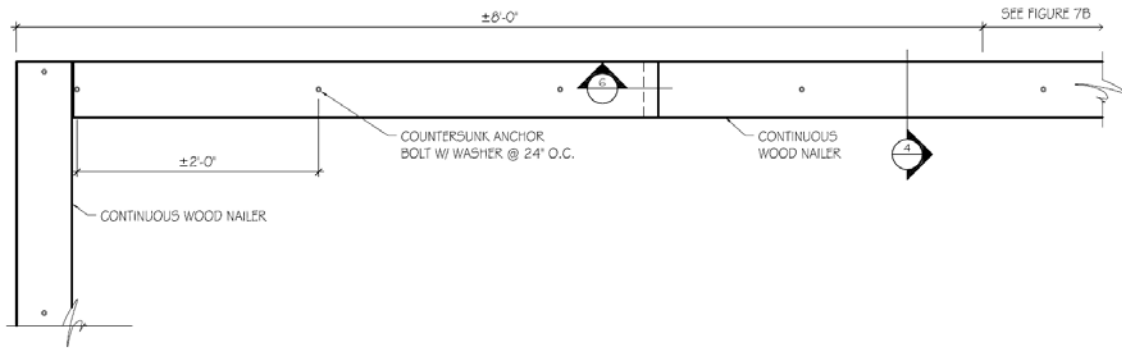


FIGURE 7A - ROOF EDGE WOOD BLOCKING @ CORNER - THROUGH BOLT ANCHORAGE 8'-0" FROM CORNER

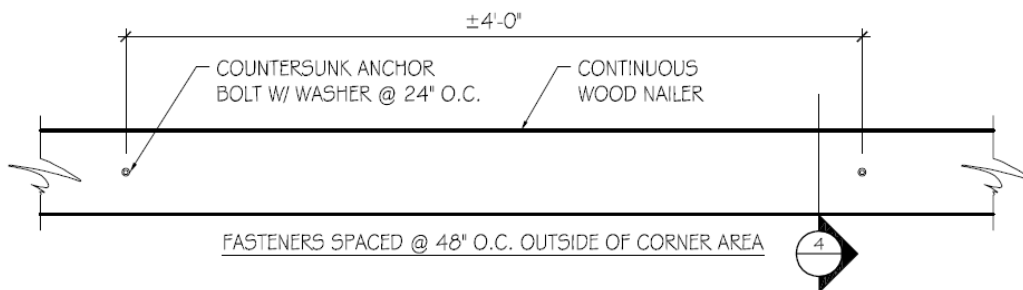


FIGURE 7B - TYPICAL ROOF EDGE WOOD BLOCKING - THROUGH BOLT ANCHORAGE

Note: These drawings show general roof diagrams. Areas that show rigid insulation can be replaced with board stock or other approved materials.

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DR-02-19

Metal Edging & Coping

October 2019

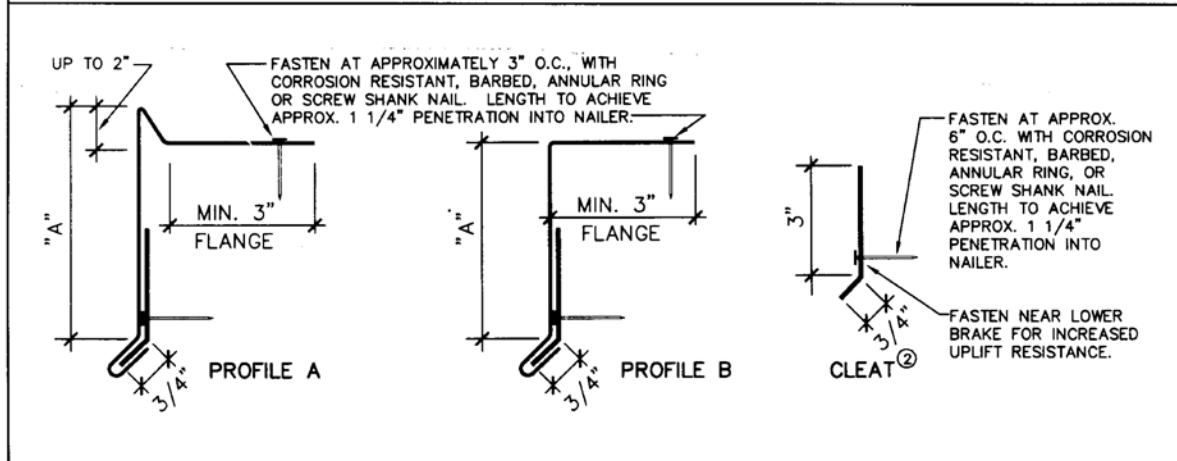
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Guide for Sheet Metal Fascia Edges

(Reprinted from the NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing - 2014)

Recommended Minimum Gauges for Fascia and Cleat ¹				
Exposed Face Without Brakes "A" Dimension	Aluminum Alloy (3003-H14)	Galvanized or Coated (G60 & G90) Steel	Stainless Steel (302 & 304)	Cleat ²
Up to 3" Face	.032"	24 ga.	26 ga.	Same gauge as fascia metal
3" to 6" Face	.040"	24 ga.	24 ga.	One gauge heavier than fascia metal
6" to 8" Face	.040"	24 ga.	24 ga.	One gauge heavier than fascia metal
8" to 10" Face	.050"	22 ga.	22 ga.	One gauge heavier than fascia metal
More than 10" Face	Add brakes to stiffen or use two-piece face	Add brakes to stiffen or use two-piece face	Add brakes to stiffen or use two-piece face	One gauge heavier than fascia metal

Recommended Profiles and Fastening for Fascia and Cleat¹



Notes:

1. Consideration must be given to wind zone and local conditions in regard to the selection of metal gauge, profile, and fastening schedule. Severe conditions or code and regulatory bodies may require more conservative designs. When using the above table, additional items should be considered, such as fastening pattern.
2. All cleats shall be continuous with lengths not to exceed 12 feet. Allow a 1/4" gap between pieces. Joints in cleat should not coincide with joints in fascia metal.
3. The securement of perimeter wood nailers, play an equally important role in the overall performance of metal fascia systems. Design Criteria for the attachment of wood nailers and associated metal edge components are also identified in the FM 1-49 Bulletin.
4. The above drawing is intended to reflect proper fastening density and fastener location when securing continuous cleats and metal edge flanges. Only metal edges with dams of sufficient height to contain entire foam thickness may be used flush at the roof level. Edges with 90 degrees drops must be elevated.

Why Specify Pre-Manufactured Roof Edges?

Top 10 Reasons

Listed below are the top 10 reasons to specify Pre-Manufactured Metal Edge Systems versus Shop Fabricated Metal:

Pre-Manufactured

Shop Fabricated

Known high quality that is consistent each time and available nationwide

Unknown, possibly poor quality, that will vary by contractor and location

Snap-on details with no exposed fasteners for a clean look without leaks

Exposed fasteners that can rust, leak, and prohibit required thermal movement

Pre-punched slotted fastener holes to assure proper fastener location and to allow for thermal movement

Fasteners driven through the roof edge in the field may be spaced improperly and do not allow for thermal movement as required

Concealed internal splice plates for smooth, maintenance free joints

Frequently use exterior “band aid” splices that are unsightly and require maintenance

Factory fabricated and finished miters, end caps, and accessories provide clean, professional appearance

Miters, end caps, and accessories are field fabricated; often yielding a cobbled together appearance

Radius sections are welded to fit the project’s actual conditions providing a smooth, finished look

Segmented straight lengths, or riveted or seamed radius, give a rough, unprofessional appearance

ANSI/SPRI ES-1 tested for wind resistance per International Construction Code as is now required in many States

No testing and may not meet local building codes

Independently tested and granted a FM approval rating by the Factory Mutual Insurance Company

No testing or FM approval

Factory finishes that incorporate Kynar 500 or Hylar 5000 baked-on architectural paint to provide a finish that is warranted for up to 20 years

Field painted edge metal is often not properly prepared to assure good paint adhesion; also, many paints will not hold up to extreme UV exposure which can result in fading and chalking over time

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DR CRFC DESIGN REFERENCE

D-03-19

Moisture in Concrete

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Moisture in Newly Poured Structural Concrete

When investigating roofs for leaks, invariably, moisture is found beneath the roof waterproofing layer, however the source of moisture is not always a roof leak. Newly poured structural concrete could be a contributor to the presence of moisture beneath a new or replacement roof.

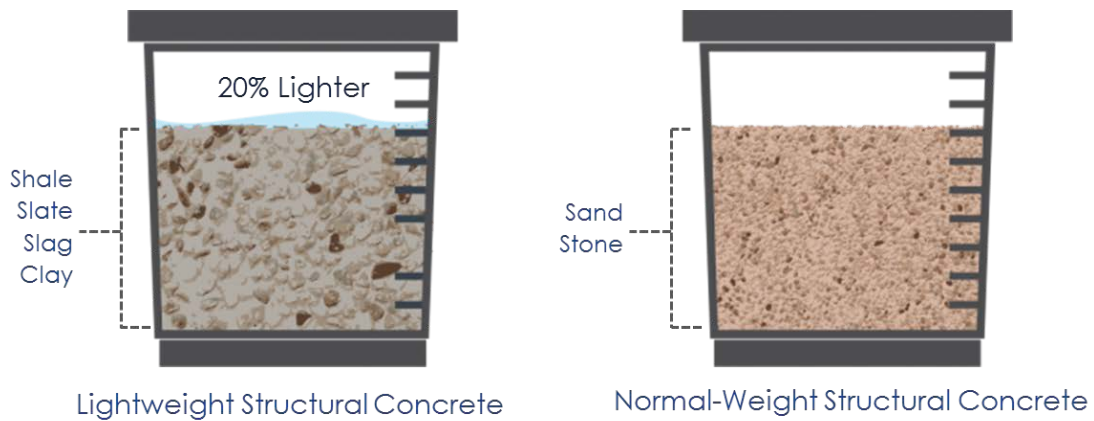
Concrete is a mixture of several components that reaches its optimum strength through a chemical reaction induced by water. Concrete needs water to allow for flowability and workability, however water has adverse effects. Once the concrete has cured, the remaining water is considered “free water”, or moisture which is no longer consumed by the curing process. Rain and snow add moisture to roof decks and prolong the drying period. As an example, a 4” slab of structural concrete contains as much as **203 gallons of “free water”** per 1,000 square feet.



Structural Concrete Mix Ratio

The ratio for both normal-weight and lightweight Structural Concrete is one and the same:

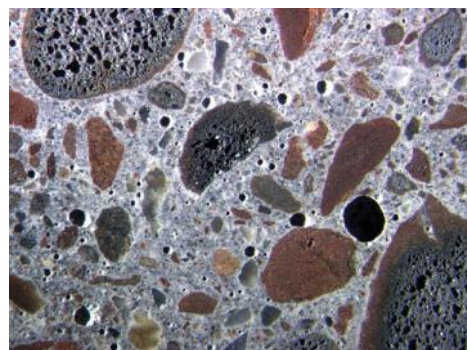
- 10-15% Cement
- 60-75% Aggregate (Fine and Coarse)
- 15-20% Water



The difference is in the aggregate, with lightweight aggregate being fully saturated before being added to the concrete mix. Light weight aggregate, made up of shale, slate slag or clay, can absorb 5 to 25% of its mass with water. Normal-weight structural concrete utilizes aggregates such as sand and stone, which are not as porous and do not need to be wetted before adding to the mix.

The popularity of lightweight structural concrete is due to:

- Lower building structural cost
- Lesser density reduces the dead loads
- Environmental and Sustainability claims



On a unit basis, lightweight structural concrete is typically more expensive than the normal-weight structural concrete.

Drying Time

To achieve a 75% Relative Humidity for normal-weight structural concrete, it will take approximately three months. To achieve the same 75% Relative Humidity for LWSC, it will take twice as long – almost six months. According to the Portland Cement Association, the dry down time for lightweight structural concrete is more than normal-weight structural concrete.

4-inch-thick Slab at 73 degree F and 50% Relative Humidity			
Water to Cement Ratio	Bottom Sealed	Bottom Surface Exposed To Water Vapor	Bottom Surface Exposed To Water
	(Over Steel Deck)	(Self-Supported Slab)	(Slab on Grade)
0.4	46	52	54
0.5	82	144	199
0.6	117	365	>365
0.7	130	>365	>365
0.8	148	>365	>365
0.9	166	>365	>365
1	190	>365	>365

Bruce Suprenant, "Moisture Movement Through Concrete Slabs", Concrete Construction

Standards for Moisture Testing

The roofing industry, has for many years, used a curing time of 28 days after the concrete is poured. However, there are test methods published by ASTM for determining the moisture content in concrete.

Qualitative tests such as the plastic sheet test, electrical resistance and/or impedance are good indicators of the presence of moisture in a given area but are not as accurate as quantitative tests.

Plastic Sheet Test



(ASTM D4263)

Electric Resistance Test



(ASTM F2659)

Electric Impedance Test



(ASTM F2659)

Quantitative tests such as moisture vapor emission rate test, surface humidity or in-situ relative humidity tests demonstrate levels of moisture present in the concrete or the rate moisture is passing through the concrete.

Moisture Vapor Emission Rate Test



(ASTM F1869)

Surface Humidity Test



(ASTM F2420)

In Situ Relative Humidity Test



(ASTM F2170)

The recommended quantitative test is the in-situ relative humidity test (ASTM F2170) which is a sleeved probe, placed in a drilled hole in the concrete and left in place for 24 hours. After the 24 hours an electronic reader is attached, and the information is read directly from the sensor. The relative humidity reading should be less than 80% at depth of approximately 40% of the thickness of the slab.



Sleeved – Instant Read

Site Considerations

The concrete pour schedule can be a factor. In phased construction, the roofing installation should be aligned with the pour schedule and Certified concrete inspectors can be utilized for moisture testing. International Concrete Repair Institute (ICRI) – concrete slab moisture testing certification program. (<http://www.icri.org/Certification/Find-CCSMTTs.asp>)

Stop Moisture Flow from The Building Interior

To facilitate down drying of the structural concrete roof deck, steps must be taken to properly vent the moisture out of the enclosed space to prevent it from migrating into the roof assembly. A well-designed air barrier system that is sealed at all penetrations and perimeters can minimize moisture-laden air leaking into the roof system.

Conclusion

- The presence of moisture is not always indicative of a roof leak.
- Lightweight Structural Concrete is wetter and takes longer to dry than standard-weight concrete.
- The Plastic Sheet Test is not a conclusive or reliable test.
- Construction sequence and roofing schedule can be a factor.

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