



▶ The Importance of Lath Embedment in Portland-Cement Plaster (Stucco)

By ClarkDietrich®

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Abstract

WHEN AN ARCHITECT, ENGINEER OR FACILITY OWNER designs and specifies an exterior plaster system, they normally focus on colors, textures, and finishes. While these aesthetic features can be created with hard-coat plaster, they don't address the functionality of the cladding system. This white paper will show why the lathing system selected is an important aspect of the overall plaster system. Specifically, the lath's ability to be embedded, or become covered by Portland-cement plaster, provides enduring cladding performance needed on a building's plaster walls.

In this paper, we will define the term "embedment" as it relates to lathing materials and the associated background of the lath and plaster concept. Furthermore, we will apply the embedment concept to various types of lathing materials installed and consider the pros and cons of each style when used. Once these insights are considered, we believe one type of lath works best in terms of plaster embedment, making it the ideal choice for a lath and plaster system.

▶ Definition

"Embedment" is an application phenomenon whereby the lathing material is covered by the plaster, with the side that touches the substrate partially covered with the plaster.

The concept of plaster embedment is defined by the International Code Council's (ICC)-Acceptance Criteria (AC) procedure, which measures product performance attributes. Specific Acceptance Criteria written protocol is used by product manufacturers to evaluate a building product's use. ICC creates the AC protocol for many building products including metal lath, prescribing values like galvanization, fastening and "embedment," in a document called the "Evaluation Service (ES) Report."

Specific to metal laths, AC 191 states:

3.6.1 Conditions of Acceptance: Metal plaster bases shall provide a minimum ¼-inch embedment between the back plane of the metal plaster base (lath) and the back plane of the plaster for a minimum of one-half of the area of the metal plaster base.

To achieve embedment as outlined in AC 191 means, when measuring a standard 27" x 97" sheet (2 sq. yards) of diamond mesh lath, the metal surface would be covered by ¼" of plaster on the front and back of the diamonds for at least 1 sq. yard (9 sq. feet) of that sheet—which is approximately 50% of the sheet's total surface area. While meeting this 50% coverage measurement is achievable for code-compliant metal laths, some design styles provide a simpler, less faulty method to improve embedment.

To achieve lath embedment, it is important to maintain consistent tightness and furring of the lath against the base sheathing when attached. Also, the pressure by which the wet plaster is sprayed or hand-troweled into and through the lath improves embedment. So, the size of the lath openings that wet plaster will cover over, under, and all around, will improve this result.

Now, we want to discuss how the AC 191 definition of embedment impacts with different types of metal laths. The three (3) different styles have their own attributes that make each attractive for their regions, with selections driven by the regions' tradition and methods of use on the jobsite. Regardless the choice of lath type, the greater the level of plaster embedment achieved during application, the less likely the plaster system is to develop compromised stucco performance.



This image shows areas where the lath has been fully embedded on all sides by the stucco—as well as areas (red arrow), where the lath is fully free-floating, with no embedment. The areas where embedment is insufficient are prone to issues from moisture penetration and corrosion.

► LATH PERFORMANCE RELATED TO CRACKING

A possible contributing factor for cracking in cement plaster is minimal embedment of the lath in the scratch-coat. When the scratch-coat does not embed the lath, it's often only applied on top of the lathing material; like “icing on cake” rather than covering through the lath. The lack of plaster and lath connectivity can cause these materials to move independently of each other when subjected to seasonal weather changes, thus developing stress cracks. While tiny stucco cracks are often found on the wall, they usually are not problematic until independent lath/plaster movements cycle a few years, potentially widening the crack. At that point, bulk water can enter through the surface.



These cracks are likely stucco curing-related, but also could be related to lack of lath embedment.

The lath's design can enhance plaster embedment by creating a monolithic cladding that moves compositely. Building wind loads and static forces that place stress on the cladding are less likely to create stress cracks if plaster embedment is achieved into and through the metal lath, creating a composite cladding.

The ASTM C926, Section 7.4.1 states:

“The first (scratch) coat shall be applied with sufficient material and pressure to form full keys through, and to embed the metal base, and with sufficient thickness of material over the metal to allow for scoring the surface.”



Stress-cracking often seen in corners can be caused by poor embedment, or omission of control joints placed for stucco membrane movement.

The spray or trowel pressure aids the wet plaster in fully embedding the metal lath. Lath types with smaller openings make it more difficult to embed, even with sufficient trowel pressure. However, the more open wire designs aid in lath encapsulation, to achieve embedment more consistently. Thoroughly embedded lath in cured cement plaster acts compositely like rebar does in concrete.

▶ CORROSION DUE TO MOISTURE INTRUSION

Moisture intrusion issues in stucco claddings are often magnified by poor embedment. In some cases, incidental moisture that may enter the plaster matrix can cause rusting and corrosion of the metal lath material if plaster is not allowed to dry out. If the moisture persists and plaster cannot dry out, its presence could result in a premature failure of the lath. The better the lath embedment, the less likely it will oxidize and eventually rust under the stucco cladding. If the plaster scratch-coat sits on top of the diamond lath, the back side of lath is minimally-covered and subsequently, exposed. As wind-driven rain and vapor drives force moisture through the plaster to the weather barrier, vapor condenses adjacent to the bare lath. If not dried out, oxidation begins and the 3 mils of zinc coating protecting the expanded metal lath begins to sacrifice, eventually eroding the zinc to expose the carbon steel. The result is lath corrosion and potential stucco failure.

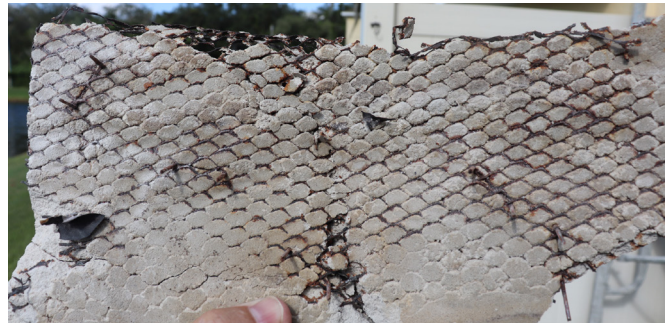
However, when the wall system combines even marginal embedment with adequate space for drainage and ventilation as outlined in ASTM E2925 of a $\frac{3}{16}$ " air gap, the cladding is more likely to resist lath rusting in the plaster. Other ventilation and drainage methods—like vertical furring strips or installing a rain screen (6 mm)—can assist greatly in draining and drying those stucco claddings that may have marginal embedment, thereby mitigating rust.



The galvanized metal lath eventually sacrifices the 3 mils of zinc coating to oxidize the carbon steel below.



Diamond mesh lath, if not properly embedded in the scratch-coat, may rust and deteriorate.

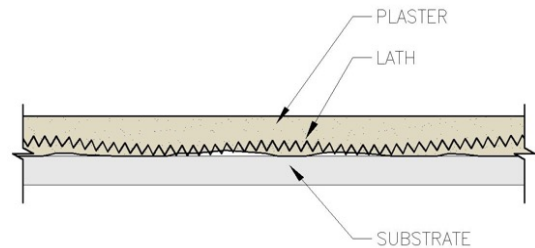


This type of corrosion, resulting from lack of embedment, can stay on the wall for many years and then finally, “give away” from a storm or wind event.

▶ LATH TYPES AND THEIR EMBEDMENT PERFORMANCE

Diamond Mesh Lath

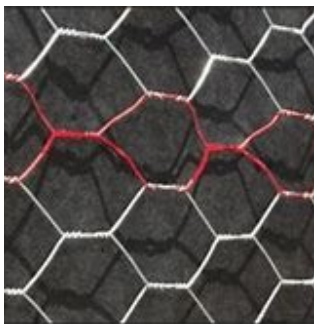
ASTM C847: Standard Specification of Metal Lath is specific to diamond mesh lath's physical properties and manufacturing tolerances. Sheet lath is defined by weight, expressed in lbs./sq. yard and the size of the diamond openings is not standardized. These openings range in size but are approximately $\frac{3}{8}$ " x $\frac{1}{2}$ " in length and width. Diamond mesh lath manufacturers engineer their sheet products to achieve the sheet weights, per the ASTM standards specified.



Expanded metal lath that is over-fastened to the substrate will restrict the passing of plaster through the diamond-shaped openings in the lath, negatively impacting embedment, especially at the edge joints and laps. Paper-backed lath—where the WRB is glued directly to the diamond mesh—increases the challenge of properly embedding the lath by amplifying the difficulties discussed above. This is due to paper-backed lath impeding the plaster from spreading through the diamonds to get to the backside of the metal lath for embedment. Because of this diamond-size variability, pressing wet plaster through the openings can be challenging. Plastering contractors often run their plaster “stiff” (i.e., less water in the stucco mixture or use of fibers) to get better surface contact with the diamonds and to assure adhesion. This stiff mix increases the difficulty of pushing the plaster through the diamonds, thereby reducing the level of embedment. While it is possible to achieve acceptable embedment with diamond mesh lath, the applicator must know where plaster mix stiffness is ideal to penetrate the diamond surface.

Wire Lath Products

ASTM C1032: Standard Specification for Woven Wire Plaster Base defines the gauge of wire, the required galvanization levels, and the opening size. Woven wire is made of 17ga.-20ga. wire that is wound into a hexagon



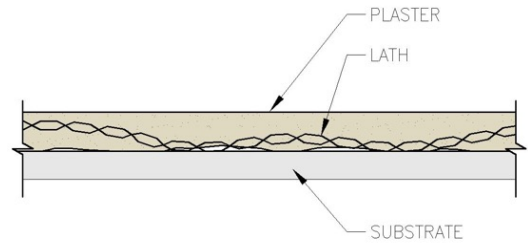
Woven wire offers little furring. The red area is self-furred, but this is often inconsistent.

with each adjoining shape woven together. Wire galvanization is Class 1, per ASTM A641, equivalent to G-60 on diamond mesh lath. While woven wire has an open design and provides for easier keying and embedment of the scratch-coat, this style faces different challenges like maintaining uniformity in furring distance on the wall. Some producers of this type of lath lack the self-furring



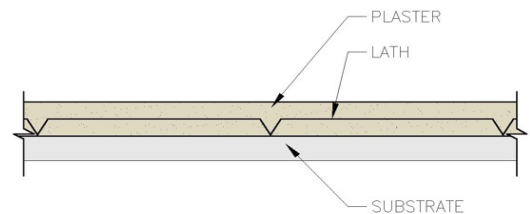
Woven wire often must be furred using nails to achieve the minimum required furring depth.

feature in the wire and don't provide the ¼" self-furring needed on the wall. The contractor must then create that proper furring depth using a special furring nail or furring wad. The self-furring inconsistency reduces the woven wire's ability to remain in the center of the scratch-coat as illustrated. Over-fastening (i.e., too many) or under-fastening (i.e., too few) the woven wire lath can restrict its ability to respond appropriately to the pressure of the trowel when applying the scratch-coat. These inconsistencies in fastening woven wire lath result in areas where embedment may not occur.



ASTM C933: Standard Specification for **Welded Wire Lath.**

This type of lath is an open-wire design like woven wire, but the manufacturing process incorporates fuse-welding at every crosswire intersection. The welding improves stiffness of the lath which enhances the wire's rigidity during installation and plastering. Because of the stiffness created in welded wire laths, it is perceived to be the easiest to embed due to the uniformity achieved by the welds and v-groove furring. Application issues that do arise are seen when wet plaster mix is hand-trowel applied during the scratch-coat. A more "wet" scratch-coat can slump off the wire before it can set. On the other hand, a drier mix may cavitate, or not fully pack around the wires. Knowing the above mixing nuances, it's important to blend a proper water/cement for welded-wire lath applications.

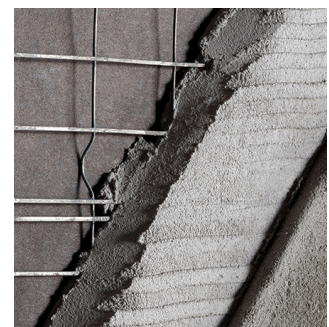


Even when considering this with wet mix quality control, welded wire lath provides a consistent, evenly furred



Welded wire lays down evenly with uniform furring.

surface that has openings wide enough to apply a proper plaster mix using the trowel to scratch—then horizontal strokes to smooth in the scratch, in preparation for the scoring lines before the brown-coat. This complete scratch-coat base will enhance the brown-coat and ultimately cut down on the number of finish-coat issues.



The scratch-coat, brown-coat, and finish-coat.

Metal Laths Have Regional History

When we consider these three types of metal laths, the plastering industry has built historical preference for lath choice for no other reason than tradition/familiarity and local availability. To understand these reasons, consider these regional differences:

- **Southeast, Northeast and Midwest**—Historically have used diamond-mesh lath sheets, because the manufacturers were in the eastern U.S. and sheets were installed by multiple trades including plasterers and stone masons. Most all lathing and plastering is paddle-mixed and troweled directly onto the metal lath.
- **Texas and Mountain States**—This area is a hybrid of diamond mesh sheets and woven wire laths. This is because much work is performed by plasterers who use pumps, and others who follow the mixing and troweling traditions often used by the stone masons.
- **Western and the Desert Southwest**—Have primarily used woven wire laths, with welded wire lath emerging as the preferred lath, and some diamond mesh still used for soffit applications. The applications done in this region are widespread and applied to very large structures, as well as most of the residential building. As such, the applications are usually mixed, pumped and spray-applied to the lath, and troweled into a finish.

Pumping Plaster vs. Mixing and Trowel: These methods are both allowed by ASTM standards and building codes. The pumping/spraying method is often seen in the western U.S. and on larger projects where volume is needed. This method of placement does improve the embedment properties of the lath as the spray pressure will penetrate the lath openings. The hawk and trowel method is more common in the eastern U.S. and often used on smaller, or more spotty areas of application that aren't continuous. This method requires the trowel operator to be skilled in placement of wet plaster into and through the metallic laths, to embed them.

A word about the use of Slickers: Long application trowels used with two hands called “Slickers” are often a preferred tool of the contractor. However, Slickers are prohibited for use by ASTM, because they tend to not fully embed metal laths. They have been shown to create cavities during wet mix application, that often cannot be seen on the surface of the scratch-coat. While this tool meets most contractors' means of application, restricting their use for scratch-coat should be specified on projects.

► Summary

In closing, [Best Practices](#) to achieve ideal plaster embedment are:

1. Fasten the metal lath through the sheathing and into the framing members without the metal lath over-fastened in-between the framing and pulled too close to the weather barrier. If furring nails or strips are used, make sure to space out to provide a ¼" elevated plane.
2. Mix the plaster scratch-coat in such a way to hang on the lath and applied with sufficient trowel force or spray pressure, so that the wet mix can be forced through the lath openings (of any size).
3. Hand trowel with vertical strokes, and cover on the lath on top, bottom and throughout the wires or diamonds to embed the lath without slumping the plaster mix. Then, apply light horizontal strokes with the trowel for smoothing the scratch-coat, so to score the wet plaster coat for the brown-coat.



This is Welded Wire Lath (ASTM C933) with PVC accessories in the ClarkDietrich Lathing System called "Easy Embedment."

Uniformly fastened and evenly furred metal lath into the framing on the wall at specified ASTM spacing, will greatly improve the embedment of the lath/plaster system and therefore, provide the best opportunity for plaster and lath to act compositely and mitigate cracking.

The above procedures help ensure that various types of metal lath will embed properly and perform for the life of the plaster system. Open wire designs tend to make lath embedment easier to achieve, with self-furred welded wire laths maintaining the most consistent furring across the plane of the surface. Lastly, specify the exact type(s) of metal lath and its associated ASTM reference that will work best for your project where installed, and its surrounding environment.

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