CHAPTER 2
PLASTER (STUCCO) LATH/SUBSTRATES
# CHAPTER 2: PLASTER (STUCCO) LATH/SUBSTRATES

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METAL & WOOD FRAMING

GENERAL DESIGN NOTES

Dead load of the building

Plaster application should always be sequenced so that the majority (90%) of the “dead load” is already put in place prior to the scratch and brown coat. Roof installation sequencing should be at the point where the majority of the “dead” load including all structural components and HVAC units has been put in place.

All interior gypsum wallboard should be installed to the backside of the exterior walls prior to plaster application to eliminate potential cracks in the plaster caused by the transferred movement or stress from the interior wall construction to the exterior walls. If this sequencing cannot happen then the wallboard should at least be “stocked” at each floor and/or room of the building in order for the building to be close to its final “dead load” weight. Weather conditions can play a role in sequencing and certain phases of plastering during the introduction of the “dead” weight or interior wall construction may be required. If at all possible, the finish (the aesthetic top coat in the already weather-resistive surface) can be delayed until the bulk of other trades have completed work that may transfer movement to the fresh plaster/stucco. This delay period will also allow any “stress cracking” that may develop in the brown coat, to be repaired without impact to the finish.

Deflection

With any plaster assembly the deflection of a plaster wall substrate should always calculate to at least L/360. This is a code-required (ASTM C 1063) calculation and the responsibility of the project’s structural engineer.
SHEATHING

WOOD SHEATHING

The APA (Engineered Wood Association) has established requirements for wood sheathing installed behind portland cement plaster.

Plywood and other wood structural panels will expand or shrink slightly with changes in moisture content. If expansion is prevented by tightly butted panel joints, buckling can occur and cracking of the plaster membrane may follow. Panel spacing is always required.

Note: Typically the gaps are present during the installation of the wood base panels; however, moisture can be absorbed into the plywood shear panels and close the gap. Wood panels installed tightly together may buckle or bow from the wall, causing cracking and/or stresses within the exterior cladding system (stucco). If the 1/8 gap is missing at the time of covering of the panel with a water-resistive barrier (building paper), the gap may need to be reinstalled, this can be achieved with a skill saw or a router.
EXTERIOR GYPSUM SHEATHING (Conforming to ASTM C 1396 and installed per ASTM C 1280)

Gypsum wallboard core is made from with which additives have been mixed to make it water-resistant. The sheathing is surfaced with a water-repellent paper to make it appropriate for exterior wall coverings. Gypsum sheathing provides backing for consistent plaster thickness and density in the wall; however, should not be relied on for shear value or waterproofing. Sheathings are not recommended behind horizontal (ceiling) plaster wall surfaces except for “DEFS” systems or to increase fire ratings.

GLASS MAT SHEATHING (Conforming to ASTM C 1177/C-1177/M)

A fiberglass faced, water resistant core commonly used as the substrate under brick, stone, stucco, EIFS and siding. This highly water-resistive product can be exposed to the element six to twelve months and still warranted by the manufacturer. Shear value is not increased. Typically, these exterior sheathing products are designed and used to provide a flat surface for the WRB (water-resistive barrier) and enables plaster thickness consistency. All sheathing panels shall be installed per manufacturer’s recommendations.

Note: Often the corners of the sheathing become damaged due to trucking, stocking or installing. These concerned corners are typically not noticed until a few sheets have been installed, generally this it’s not a problem (WRB will cover the void). When it becomes an issue, sealant can be applied into the void.

CEMENT BOARD (Conforming to ASTM C 1325)

A combination of cement and reinforcing fibers formed into 4 foot by 8 foot sheets (or 3 foot by 5 foot sheets), 1/4 to 1/2 inch thick and is typically used as a tile backing board. Cement board can be nailed to wood or screwed to steel studs to creating a substrate for vertical tile and attached horizontally to plywood for tile floors, kitchen counters and backsplashes. It can be used on the exterior of buildings as a base for select exterior plaster (stucco) systems and sometimes as the finish system itself. Cement board adds impact resistance and strength to the wall surface. However, these products are generally not recommended as a suitable substrate for most plaster assemblies.

LATH (PLASTER/STUCCO BASE)

The plaster base for the purpose of this document is composed of three components:

- The water-resistant barrier and will be referred to as WRB
- Self-furred metal base consisting of lath, woven or welded wire/mesh
- Metal plaster accessories
1) WATER RESISTIVE BARRIERS (WRB)

PAPER, FELTS AND VAPOR PERMEABILITY

Water-resistant backing for cement plaster has traditionally been an asphalt saturated kraft paper. This generic product has proven to work well behind cement plaster for decades. Asphaltic papers and felts are still viable choices for the WRB behind cement plaster. Asphaltic building paper has some unique qualities that make it a good and unique fit for cement plaster. Roofing felts should not be used behind cement plaster due to lack of vapor permeability.

Back in 1976, the Uniform Building Code adopted new requirements for water-resistive barriers and now the International Building Code follows the same requirements of requiring two (2) layers of a vapor-permeable WRB equal to Grade D building paper when plaster (stucco) is installed over wood-based sheathing. The material is manufactured in rolls in single sheets or in double (Two-Ply) paper to meet the code. Single-ply paper comes in three ratings for water resistance: 10, 30 and 60 minutes per layer. Two-ply paper usually consists of two layers of 60 minute paper “rolled together”. Documents like ASTM C 1063, the lath standard referenced in the code, refer to the WRB as simply “backing”.

Grade D Building Paper:

Allowable time exposures to the elements for water resistive barriers vary due to atmospheric conditions, exposure to sunlight and abuse resistance. Generally, Grade D building paper can be exposed to the elements for thirty (30) days. Exposure to extreme elements can shorten this period while protected areas can have longer exposure times. Hot, dry and extreme exposure to the sunlight can leach the asphalt out of the Grade D paper. This is visible as the paper fades from a rich, dark black, to a light brown or grey.

Swelling and Channels: Asphaltic building paper will swell when wet. This has multiple benefits for cement stucco. 1) The swelling helps seal small penetrations used to attach lath. Fasteners for lath should be along framing members; this also helps create a seal. Asphaltic paper and lath, properly applied, will not leak.

The first (scratch) coat of cement will cause the paper to become wet and as the paper swells and wrinkles, shallow waves create a drainage plane for water between the cement membrane and the asphaltic paper.

Synthetic “Wraps”:

Most synthetic papers are able to withstand longer exposure to UV (ultraviolet) light as compared to asphalt saturated kraft papers. When using synthetic wraps, consult manufacturer for allowable time exposure. Synthetics should have the same bond breaking ability with cement to perform similar to asphalt saturated kraft papers or a single layer of Grade D paper can be applied over the synthetic paper prior to the application of the lath. A synthetic paper or “wrap”, proving to be an equal to Grade D paper, has increased in popularity in recent years. They have superior tear and UV resistance and some have “built-in” drainage planes. However, they are more costly than building paper and it has been documented that plaster may bond to some “synthetics” which may inhibit the drainage plane capacity. In cases where the stucco may need to be removed (patching, additions, damage, etc.), it may be impossible to remove the plaster without damaging the WRB.
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The “wrap” products meet code requirements and perform very well as a WRB. When they are used or specified, many plaster bureaus including TSIB recommend a “slip sheet” of Grade D building paper installed between the “wrap” and the plaster. The combination of papers will meet code requirements.

LIQUID APPLIED WATER RESISTIVE BARRIERS

These products are gaining in popularity as the perception of holes created to attach the WRB is considered problematic. This is not entirely realistic as the fastener used to attach the lath is significantly larger. These products are relatively new to the market and can be a significant up charge in cost. Designers are encouraged to consider the real and full value of “alternate” products, verify testing and code compliance before specifying. If selected, follow the manufacturer’s recommendations.

WRB APPLICATION

Applying Two Layers: Application of two layers of water resistant barrier (WRB) may be done in a variety of ways. For simplicity there are three (3) basic methods:

1. The “Double Layer” Method
   a. This is a common method when a roll of “Double” or “Two” ply product is used. Both layers go on in one operation; each upper layer overlaps both lower layers.

2. The Single “Separate” Layer Method
   a. The method is often used when applying two different products. Each layer is applied separately from each other.

3. The 50/50 Method
   a. This method is a single layer that is overlapped by at least 50% by the upper succeeding layer of WRB. This ultimately gives you two (2) layers

   Best Method: The International Building Code states the “Single” layer method is the new required practice. If the other methods are preferred by designers, consultants or installers, they should verify the procedure with the local Building Department prior. Each method has advantages and disadvantages.

Application shall start at the base of the wall and lap the flange of flashing, weep screed or any device used to weep moisture out from behind the cement membrane.

The WRB shall be applied taught with a minimum of wrinkles and with care as to not allow the WRB to be punctured, torn or ripped during application and the application of metal base (lath). Code requires that laps be a minimum of 2 inches. Some WRB manufacturers or proprietary systems may recommend or require a larger lap. All layers shall be installed in a “shingle or weatherboard fashion”, meaning upper layers shall overlap lower layers. The WRB should overlap trim upper attachment legs of accessories and overlap the foundation weep screed. This “shingle” fashion should include all integration with flashings, flashing papers and other secondary water barriers used under other exterior claddings.
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Attachment of the WRB is best done with a small hand held stapler. The legs of the staple should not exceed 9/16 of an inch and have a crown of at least ½ inch wide. This light staple will not penetrate the layer of sheathing. The holding power is limited, so it is recommended to apply and secure the metal base over the WRB the same day.

It is NOT typically recommended to use sealants around the fastener penetrations, unless the hole is large or visible. Field of the wall leaks is not common. Sealants can absorb asphaltic solution or have other negative impact on the WRB and possibly degrade or shorten the life of the WRB. The build-up of a sealant will create variations in cement membrane thickness; this can lead to unnecessary cracking. Large holes, tears or punctures should be repaired.

WRB Protection During Construction

The industry recommends keeping the exposure of the water-resistant barrier to a minimum prior to covering with the exterior cladding. Prolonged exposure to sunlight, wind, moisture, job site dust and dirt, and other detrimental elements can promote degradation of the water-resistant barrier. Prolonged degradation may lead to failures of the exterior envelope and moisture migration.

WRB ON CEILINGS, MASONRY AND CONCRETE

Generally it is not recommended to use a WRB on ceilings, larger soffits, masonry and concrete substrates. There is no need or benefit for a WRB on ceilings.

The addition of a sheet good WRB between cement plaster and a concrete or masonry substrate is not usually advised. History has taught us the practice of installing a WRB over a masonry or concrete wall for cement plaster has created more problems than it solved. Designers and contractors should exercise caution to overcome the following problems associated with applying a WRB over masonry/concrete.

1. The attachment of the WRB as a standalone product is not realistic and paper backed laths is most often used. The attachment will need to be done with a power actuated device. This device will typically tear larger holes into the WRB, thus negating the perceived added moisture protection.
2. Power actuated fasteners or concrete nails used for attaching paper backed lath to concrete/masonry can have spalling problems, and since the WRB is solid, the visual confirmation of a secure attachment of the lath to the substrate is not possible.
3. Generally lath should be attached at grout joints; the installers will not be able to see the grout joints through the solid WRB.
4. The WRB acts as a “bond breaker” between the cement plaster and the substrate. This is proven to be an undesirable situation and can lead to premature assembly failure.

If additional water protection is required, it is recommended to use a liquid applied WRB or coating that allows a bond to the cement plaster. Most EIFS manufacturers have such products readily available. The other option is to apply a polymer enriched base coat and fiber mesh over the brown coat (insure the skim coat and finish coat are compatible).

2) METAL PLASTER BASES (LATH OR WIRE)

Codes and standards often refer to lath as the metal plaster base. Lath is required for all cement plaster applied over framing, and may be used over solid masonry/concrete substrates. The manufacture of the various laths is recommended to be under the standards of the ASTM specific to that product.

- ASTM C 1032 - Woven Wire
- ASTM C 847 - Expanded Metal Lath
- ASTM C 933 - Welded wire
- Proprietary ICC report - Plastic Lath
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Expanded Metal Lath

**Material:** Expanded metal lath is the oldest of manufactured modern laths, and commonly used in commercial and institutional projects with metal framing. Expanded metal lath is made from coils of sheet steel, slit and expanded into a herringbone pattern or diamond shape. The diamond shape openings have allowed some people to refer to this a “diamond lath”. The sheets are typically 96 ½ inches long by 27 inches wide. This lath comes self-furred or non-furred using “V” grooves or dimples. Expanded metal lath comes in three weights, 1.75, 2.5 and 3.4 lb per square yard. It is generally preferred to use the heavier lath for best results. However, there are circumstances where a lighter lath is adequate and may even be preferred. For example, a ½ inch of cement plaster over a painted masonry wall would not require or benefit from a heavy lath.

**RIBS:** Expanded metal lath also comes in flat and HI rib configurations. The ribs act as stiffeners to add support for the application of plaster when applied to open framing. It is not a stronger lath. Flat rib is for open spans of 16 inches, HI rib is for spans up to 24 inches.

**Installation:** Overlaps shall be 1 inch on ends, not to exceed 4 inches, and 1/2 inch on edges, not to exceed 2 inches. Attachment shall be six (6) to (8) inches on center along framing supports. An occasional fastener between framing supports is acceptable on sheathed walls. Nails, staples and screws are acceptable for sheathed walls. Wire tying is used for attachment to ¾ inch furring channels.

**Caveats:**
- Furring wad nails cannot be used with expanded metal laths.
- Expanded metal lath is designed for metal framed walls with or without sheathing, masonry and concrete substrates.
- Ribs in expanded metal lath can lead to straight line cracking in plaster and only recommended for open framing (no sheathing).
- Hi rib is only recommended for open framed soffits (small ceilings) where framing is 24 inches on center.
- California has special requirements for attachment of rib lath.
- Rib lath should not be used over solid substrates.
- Ribs (hi ribs) shall be nested.

**Technical Services Information Bureau**

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Welded Wire

**Material:** Welded wire lath was traditionally in a 2 inch by 2 inch square pattern and made from a 16 gauge wire. This lath was common as a tile backing lath for decades. Recently, manufacturers reconfigured the lath to smaller 1 ½ inch openings and made with 17 gauge wire to allow easier and better use for traditional cement plaster. This product also came with “U” shaped furring points to allow better plaster embedment. For metal framing, a second strand of flat wire (double strand) has been added to allow attachment with a standard wafer head or modified truss/lath screw.

**Installation:** horizontal overlaps shall be sufficient to fully cover a square opening, but should not cover more than 4 openings. Vertical overlaps shall be a minimum 6 inches or extend to the next stud. Attachments can be staples, nails or screws and of a type capable to engage the two strands of wire.

**Caveats:**
- The 2 inch by 2 inch openings are not sufficient when used to cover a solid style flange of trim accessories. Use strip lath.
- It is recommended to use double strand style welded wire lath when using screws for attachment.
- Not recommended for ceilings unless a proprietary wire that allows full embedment of the plaster and manufactured specifically for horizontal conditions.

Woven Wire

**Material:** Erroneous called “chicken wire”, woven wire has been the standard for the residential plaster work for several decades. Woven wire lath is available in two sizes, 1-1/2 inch openings with a 17 gauge wire is for traditional 3 coat cement plaster. 1 inch openings with a 20 gauge wire is designed for thinner “one coat” plaster systems.

**Installation:** Laps should be a minimum 1 lap (approx ½” inches) at sides and ends (horizontal) and 6 inches or Attachment is 6 inches on center along vertical studs and with nails, staples or screws. Do not over fasten.

**Caveats:**
- Not recommended for ceilings.
- Not recommended for metal framing.
- Not the best choice for masonry or concrete substrates.
- No need for furring wads when self-furred lath is used.
- Excellent for wood framed walls and proven to provide added benefits in the event of a seismic event.
- This lath can be tightened by twisting the eyelets between framing members.

Paper-Backed Lath

**Material:** Almost all laths can come “Paper-Backed”, meaning the paper (water-resistive barrier) is bonded to the lath. The paper is typically a grade D paper and complies with code requirements for a water-resistant barrier. While this product allows applying the WRB and the lath to occur in a single step operation, there is an up-charge cost for material and installation is more sensitive. Most plaster bureaus recommend limited usage of paper backed lath and careful consideration to cold joints and flashing procedures.
Installation: while it would seem that covering two operations in a single step is wise, it can cause problems. When installing paper-backed lath, installers must avoid “cold joints”. A cold joint is when paper and wire lap paper and wire. Proper installation is paper over paper and wire over wire.

Another concern is flashing and proper integration with trims and flashings. It can be challenging to insure the paper backing is installed in a “shingle-fashion” 100% of the time.

Caveat:

- Contractors should inspect product prior to installation to verify the paper backing is water-tight prior to installation. Pin holes can occur during shipping, the problem can be solved by installing a single layer of water-resistant barrier prior to the paper-backed lath.
- Do not use low cost labor to install paper-backed lath, only qualified lathers should be used to install paper-backed lath.

Glass Fiber (Plastic) lath

Material: This lath is new to the industry and has yet to proven itself through several successful projects. Designers and contractors are cautioned to review all data before specifying this new lath. The product should have an evaluation report for code approval.

Installation: per manufacturer’s instructions.

Caveats:

- This product has a proven track record in Florida over masonry and concrete substrates.
- Since cement plaster bonds to rigid insulation, plastic lath is an appropriate selection for “Continuous Insulation” plaster assemblies.

Line Wire

Material: Line wire is used to provide backing for the building paper when no sheathing is used. The 18 gauge wire is commonly called “tie” wire and comes in rolls called “stones”. The use of line wire for “open wood stud” construction may be preferred, but is legal in all building codes and standards.

The wire is stretched horizontally across the wood framing (studs) spaced approximately 8 inches apart and will provide adequate backing when the first coat of plaster (scratch) is applied. The practice has decades of success in the southwestern United States.

Installation: to install line wire over open wood studs, it is necessary to drive 4d nails approximately half way into the wood stud or furring strips with a spacing of approximately 8 inches on center. It is recommended to apply the “half driven” 4d nails every fourth stud from bottom to top of wall. Starting at base of wall run the 18 gauge galvanized line or “tie” wire in a horizontal direction, looping the wire on every half driven nail. After the line wire has been run, drive the 4d nails home, without damaging the wire. To tighten the wire, use a 4d nail at middle points (studs without nails) and place under the loose line wire lifting to make the wire taught, drive nail home. To tighten the line wire further, if required, another 4d nail can be place on the succeeding stud “above” the line wire and pulled down and driven home. Line wire to be installed perfectly horizontal and level is not needed and not possible.
For narrow openings, such as between doors, it is acceptable and industry practice to run the line wire in a “Z” pattern up the wall. The intent is to have a fairly taught run of line wire, with openings (spacing of wire) not to exceed 12 inches.

Caveats:
- Line wire is used only on wood studs.
- Not needed for sheathed or solid surface walls
- Not recommended for ceilings or soffits
- Not recommended for metal framing.
- Traditional application is with 4D “blue” nails, longer nails are not recommended
- Some sheet lath products have line wire integrated within the product.
- Maximum recommended framing spacing is 16 inches on center.

General Lath Installation Caveats:
- Prior to lathing, all flashings, window frames, door frames and backing should be in place.
- Transitions from other claddings should have the water-resistant barrier extend nine (9) inches for vertical transitions and four (4) inches for horizontal to insure a continuous secondary moisture barrier.
- Sides and ends of lath should be lapped as required so adjoining sheets or rolls become fully embedded in plaster.
- Do not terminate lath at vertical corners, unless the corner is a transition to another cladding.
- Installing lath reasonably flat, so as not to protrude beyond the set plaster grounds is important, but it is not recommended to over fasten or install lath to be completely flat and negate furring.
- Fasteners should be spaced approximately 6 to 7 inches along framing support.
  - Wood framing: Penetration into wood a minimum ¾ inch
  - Metal Framing: Screws shall penetrate the framing member a minimum of three threads.
- Wire ties are used for attachment to cold-rolled channel (furring) a butterfly tie or twist tie is also acceptable.
- All lath shall lap the solid style flange of trims by a minimum 50% the flange width.
- Lath may be continuous behind “single-piece” control joints where specific conditions are present that prevent the attachment of cut ends of lath. These joints are referred to as “Architectural Joints”.
- Prior to plastering, a job walk to inspect the “WRB” and flashings is appropriate, all tears or large holes should be repaired prior to plastering.
- It is not recommended to seal around lath fasteners. Refer to “Water Testing” for more information.

3) PLASTER (STUCCO) ACCESSORIES

Material: Trim accessories for cement plaster (stucco) may be made from galvanized steel, anodized aluminum, PVC, or a zinc alloy. Trim accessories include weep screed, casing beads, corner beads (aids) control joints, expansion joints, reveals, vent screeds, and various other screeds. Virtually all trim accessories will set the depth (grounds) for the thickness of plasterer. This is the true measure of how thick the plaster is to be applied. The following are common trim accessories and their recommended uses:

FOUNDATION WEEP SCREED

Description: A solid flange product used at base of framed wall to separate plaster from earth. Prevent capillary action from ground water up framed wall and allow moisture to any incidental moisture that finds its way behind the plaster to “weep” out. First established as a requirement from the Federal Housing Authority for stucco homes (originally called FHA screed) and appears first time in the 1973 Uniform Building Code.
The accessory is normally made from galvanized metal, but can be made from other materials. Weep screed with a "V" shape rigid nose, is also referred to as a #7 style weep screed. Typically comes in 7/8 inch grounds and a 3 ½ inch solid back flange.

In the past, the accessory was made with holes in the upper and lower flanges. Many construction authorities feel the holes are necessary to facilitate weeping. According to long time plastering industry expert, Walt Pruter, the holes were a HUD requirement because “they did not understand how the design of the accessory was suppose to weep water.”

Today, manufacturers will make the foundation weep screed with or without holes because the holes are not necessary for weeping. The accessory weeps water by directing it off the water-resistive barrier and down the sloped upper flange. Holes may be discouraged in certain application as they can be a pathway for insects to gain entrance into the building. They also tend to get clogged up on the lower flange when the screed is applied to a curb that gets sacked. This tends to concern building inspectors who require the installer to go back and clean out the holes.

The foundation weep screed is not a pathway for a torrent of water. Very little water makes it down to the weep screed in a normal period of precipitation. Most of the water is absorbed into the plaster, distributed by wicking action, and evaporated back into the atmosphere or simply washed back over the exterior face without ever entering the plaster system. Water tests done with a rack introduce more water into the plaster assembly then in any natural water occurrence and those are the opportunities where many observers watch the weep screed flowing unnatural amounts of water out of the assembly.

**CASING BEADS OR PLASTER TERMINATION ACCESSORIES**

**Casing Beads**

*Description:* A trim used to terminate plaster, sometimes called “milcor”. Casing beads may be made from metal, aluminum, zinc allow or PVC. The flanges are standard, short flange or an expanded flange style. Standard flange is most practical and common. Short flange is for tighter areas, and expanded flange has expanded metal lath and typically used over masonry when no lath is used. Grounds come in 3/8", ½", ¾" and 7/8" thickness. Smaller grounds (one coat stucco) and larger grounds (“CI” plaster) are also available and can be special ordered. Attachment should be secure to framing or masonry/concrete and not exceed 36 inches on center.

Casing beads make an excellent surface to which a quality sealant will bond to form an air and watertight and are used around penetrations and termination of plaster. The Water Resistant Barrier typically laps into the casing, except at locations where this would be a “reverse lap”, such as under windows with flashing paper,
The casing is placed over the WRB. It is not necessary to interlock casing beads for proper installation. Proper attachment to framing within two inches from the ends of the casing bead will securely hold the casing bead securely in place.

Back flanges have historically have been sold with perforations. In today’s world, plaster terminations are increasingly asked to work as flashing accessories which requires the back flange to be non-perforated and like the foundation weep screed, 3 ½ inches.

**Exterior Corner Reinforcement**

_Description:_ A trim piece that provides a rigid exterior corner and may be expanded metal or a welded wire product (Corner Aid). Corner aid is typically the preferred product for stucco installations. Cement finish stucco should use a wire nose aid, and acrylic finish stucco should use a plastic nose aid.

Cement finish will stick to the plastic, but not bond and will flake off in time. Acrylic finish can cause metal nose aid to rust if exposed to repeated moisture.

Attachment of corner beads or aid may be with wire tying, nails or screws. The attachment shall be made secure to resist movement during the application of plaster. Attachment points are typically spaced at 36 inches or in thirds along the length of the trim. Corner trim shall be set to level/plumb to within a tolerance of ¼ of an inch in a ten feet span. Only the finish coat covers the corner trim.

**Welded Wire (Corner Aid)**

Corrosion-resistant welded wire external corner reinforcement (commonly referred to as corner aid) with their large openings and a wire nose is the preferred external reinforcement for cement stucco applications. Welded wire allows the plaster to encase and fill the entire corner with plaster. This provides a strong and solid corner. Welded wire corners come in straight pieces of 96 inches in length; square or bullnose shapes are available. Welded wire is also available as an “Archaid.” This reinforcement allows for the welded wire to be curved to a smooth radius. The flanges of welded wire corners are typically 2 ½ inches wide. A short flange is also available and is specifically designed for returns with limited room.

**Expanded Flange Corner Bead**

Corner beads, originally developed to reinforce gypsum plaster, eventually found usage in portland cement plaster (stucco) because they were readily available and are easily installed. Although corner beads are helpful in establishing grounds and defining plaster corners, they have several downsides when used in exterior portland cement plaster (stucco). The solid corner is metal and while cement sticks to metal, it will not uniformly bond; causing the stucco to flak off and/or separate. In addition, water can accumulate in the hollow core of the corner, which may lead to premature deterioration and rusting.
“Bullnose” Corner Reinforcement & Soft Round Corners:

Occasionally a designer wants a corner more rounded than what a bullnose aid can provide. In some cases corner framing may even be altered to accommodate a softer radius. In these instances, the installer may use strip lath as corner reinforcement. Strip lath comes 6 inches wide by 96 inches in length and is made from expanded metal lath.

CONTROL, EXPANSION JOINTS, REVEALS & ATTACHMENT

Control & Expansion Joints

Control and expansion joints are the most confusing and important of trim accessories and used to relieve thermal, structural and seismic stresses. Proper location and installation of these trims can greatly reduce the incidence of cracking due to one or more of these stresses. All required flashings except those providing ground for plaster shall be installed by others. Reference: ASTM C-1063 and manufacturers recommendations and specifications.

Control Joint

Generally refers to a flexible, single piece component designed to control the less extreme thermal stress and normal shrinkage in cement plaster: for movement of less than ¼ inch and in one direction only.

Expansion Joint

Generally refers to a telescoping two or three piece designed to control structural or seismic stress: for movement that will exceed ¼ inch that may occur in more than one direction. Back to back casing beads with a backer rod and sealant can also act as an expansion joint and allow minor relief in three directions.
CHAPTER 2 - LATH / SUBSTRATES

Reveals

Description: reveals are one-piece trim accessories used to add architectural definition to a wall. Reveals may be made from aluminum, PVC or galvanized steel. Reveals are generally U shaped and come in a multiple of widths, ground depth or configuration. They may be placed directly over the Water-Resistant Barrier, but the lath must not be continuous and must lap the solid flange by a minimum of 50% of the flange width. The Water-Resistant Barrier “may” lap the flange of a horizontal one-piece reveal and only on the upper flange, the lower Water-Resistant Barrier must extend up behind the entire reveal by a minimum of two inches.

Attachment is through the solid flange to framing members not to exceed 36 inches. When use on masonry/concrete substrates, a solid flange must have a strip of lath covering the flange and extend onto the solid substrate a minimum of 4 inches. Some reveals have perforations on the flange to allow for cement to “key” and integrate with the trim piece. Intersections, terminations and junctions of reveals should be back sealed with a quality sealant to prevent water entry. This is more critical in locations exposed to wind-driven rain. The lip or “outer flange” may be exposed or covered with plaster. The important item is to be consistent. It is possible in areas with extreme temperature swings that a hairline separation may occur between the outer lip and the plaster membrane.

Vent Screed

Vent screeds come in a variety of materials and are used to allow code required ventilation in concealed spaces. Vent screed also come in a variety of widths and ground thicknesses. Most vent screeds are used on soffits or ceilings and have small holes allowing for ventilation. The holes should be covered prior to machine application of plaster to prevent clogging.

Drip Screed

This type of trim accessory is used at transitions from wall to soffit or ceiling. The intent is to provide a clean transition and allow any incidental moisture that make have accumulated to weep or exit. It is not required to have a drip screed at every wall to soffit/ceiling return. The designer must take into account the wind driven rain exposure, the depth of the soffit/ceiling and make a decision as to the need for a drip screed. Generally, regions with low annual rainfall, small returns (soffits/ceilings) or small wall exposure above the transition, do not need a functioning drip screed.

Specialty Trims

There are many trims becoming available as stucco finishes become more and more popular. It is recommended to research the success of the trim, consult a plaster bureau or qualified contractor and follow manufacturer’s recommendations for usage.

“Inside Control” joint (known as #30 joint)

This joint can be installed at inside corners to reduce transferred stress for one wall to the next. The accessory can also work well when transitioning from textures and color changes from one wall to the next at inside corners. The joint is an excellent transition piece when a plastered vertical wall transitions to a plastered soffit or ceiling condition.
Control & Expansion Joint Design & Placement:

Wood and Metal Framing
Portland cement plaster should be kept in panels as square as possible. L shaped panels should be avoided. Narrow panels should not exceed 12 feet in length. Panel size should not exceed 3 to 1 ratio.

Panel Size
Panels on sheathed construction with metal or wood framing should be approximately 144 sq. feet. Maximum recommended length of a panel is 18 feet. Concrete block or concrete experience minimal compression and thermal stresses, and greater spacing is allowed. Control joints should be installed on concrete or concrete masonry construction (with lath reinforcement) not to exceed 250 square feet.

Typical locations for control joints would include:
- Off corners of window and doors
- Structural plate lines (expecting minimal movement)
- Junctures of dissimilar substrates

Typical locations for Expansion joints would include:
- Structural plate lines (expecting significant movement)
- At structure expansion joints

Installation
Blocking and backing must be provided for the attachment of control and expansion joints. Attachment spacing should never exceed 36”. The Water-Resistive Barrier must be continuous behind all control and expansion joints.

Control joints should be placed over framing members and may be placed over continuous lath. If the lath is to be cut behind the control joint, there must be sufficient framing for attachment of the lath termination (ends).

Expansion joints must have the lath cut and lap the attachment flanges of the expansion joint.

Pieces shall be of sufficient length to allow positive alignment and attachment. Attachment shall be often enough to maintain alignment and resist pressures of plaster application.

Vertical control joints should pass through horizontal control joints. Vertical control joints must terminate at horizontal expansion joints.

Control and expansion joints shall be cut and fit neatly together at intersections. It is recommended that in areas subjected to wind-driven rain, control joint and expansion joint terminations/intersections be set in sealant or buttons of sealant, for wet locations.

Trim Accessory Caveats:
- Control or expansion joints, corner beads, casing beads, wood grounds, weep screeds or other trim accessories are used to terminate all plaster surfaces. These items can provide reinforcement and proper alignment to the edge of plaster panels.
- Where plaster panels abut dissimilar materials, generally a 1/4 inch or more separation can provide some stress relief, in some cases there may be a need for a sealant.
- On multi-story wood framed buildings 3/8 inch relief should be provided at the head of each door and window penetration, except at the top floor.
- Multi-story wood framed buildings (over two floors) should have expansion joints placed at floor lines in lieu of control joints.
- Welded wire corner beads are used at exterior corners and control components may (but not required) be used on interior corners.
- To allow moisture to escape from a portland cement plaster (stucco) assembly, no sealant should be placed at the bottom of the plaster termination.
CHAPTER 2 - LATH / SUBSTRATES

- Proper design and installation of control and expansion joints in a portland cement plaster cannot guaranty against cracking.
- Control joints and expansion joints shall integrate (align) with all other plaster trim accessories.

CEMENT PLASTER CEILINGS/SOFFITS

Cement plaster is often selected for exterior ceilings and soffits for the fire-rating, low maintenance, abuse and moisture resistance. Metal lath can be directly attached to the framing joists, furred or suspended, refer to ASTM C 1063. Another option is the Direct Applied System (DAS), this proprietary system incorporates a highly water resistant sheathing, treated joints, a mesh embedded in a skim coat of polymer enriched cement and an acrylic finish coat. This system is not recommended for walls exposed to wind-driven rain, but proven excellent for all ceilings and soffit conditions. Follow manufacturers ICC Legacy report for specific requirements and recommendations. The installed cost of a DAS ceiling is generally less than that of a three coat-cement plaster ceiling.

Caveats:

Plaster ceilings are appropriate for all types of construction. Contact ceilings with plaster are more common in residential construction and furred or suspended plaster ceilings are more common in commercial construction.

Plaster may be applied to a concrete ceiling. Plaster Bureaus do not typically recommend that a three-coat plaster system be applied to concrete ceilings. It is generally recommended that only skim coating with plaster be done to concrete ceilings.

Gypsum plaster is recommended for ceilings where fire resistance, sound attenuation is a primary concern. Gypsum plaster basecoats absorb sounds better than portland cement plaster, have a higher degree of fire resistance and can be finished to any desired texture, including smooth trowel.

Special high strength gypsum basecoat plaster is available for high security areas and suitable for facilities requiring high security. However, the limitation for gypsum plaster ceiling is exposure to water. Gypsum plaster is not intended to be exposed to water and/or constant high humidity. Interior spaces with de-humidification systems may be suitable for gypsum plaster.

Portland cement plaster ceilings are recommended for building exteriors. These ceilings can withstand repeated wetting and/or constant high humidity. These ceilings are highly abuse resistant and provide fire ratings when framing do not exceed 16 inches on center.

Suspended Lath and Plaster Ceilings

Suspended lath and plaster ceilings have been part of the building codes since their inceptions and chosen for most commercial buildings when ultimate performance ceilings is desired and when initial installation cost is secondary. From abuse resistance to sound attenuation and control, nothing can compare to a suspended plaster ceiling.

The main runners are typically 1 ½ inch cold rolled channels suspended from the structure by 8 or 9 gauge hanger wires.
¾ inch furring channels are saddle tied perpendicular to the main runners, metal lath is then butterfly tied to the furring. This time honored method has proven less likely to induce cracking than hat channels with metal lath screw attached to the hat channel.

Wire tying allows for some incidental movement while still providing a secure and safe attachment. Screw attachment is a predominantly rigid attachment with less allowance for movement between connected materials. This allows the suspended plaster ceiling to float, flex and remain secure with the wire tie attachment. The wire tie allows for some movement and minor stress relief without compromising the security of the attachment and thus reduces the stress placed upon the rigid plaster membrane.

The wire used for tying lath, channels and runners is galvanized and soft tempered annealed wire. Several types or styles of ties are used in the installation of metal supports and metal lath.

**Caveats for Lath and Plaster Ceilings**

- Sheathings are not required for plaster systems installed on ceilings/soffits. In most cases, they are not recommended for lath and plaster ceilings.
- Hat or drywall furring channels, while allowed, are not typically recommended for plaster ceilings. The raised lip along both edges on the face of the channel can produce a sharp defined line into the backside of the plaster. This unintentional score line can result in a crack when the ceiling is subjected to enough stress. When a hat channel has been used as cross furring with the intention of screw applying a metal lath, it is recommended to install a sheathing to minimize the increased potential of cracking.
- Water-resistant barriers (building papers) are not typically recommended for plaster ceilings. Paper-backing that is used by the manufacturer of the lath, to provide a backing for machine applied plaster, is acceptable.
- Rib-lath, particularly hi-rib lath, is not typically recommended unless spacing of the framing supports requires the use of a rib lath. The ribs in the Hi rib lath produces an unintentional score line in the backside of the plaster. This deep straight groove is a weakness in the plaster membrane; cracks are often noted along the rib after plastering is complete. Hi-rib lath was created for the sole purpose of providing a rigid base allowing cement plaster system to be applied to framing supports spaced 24 inches on center. This is more common on residential eaves and acceptable for that usage. It is recommended that Hi-rib lath only be used for that purpose in plastering.
- It is typically not recommended to attach the perimeter of large suspended plaster ceilings to partitions, unless there is a substantial use of control joints in the ceiling to allow relief. Rigid attachment of the suspended plaster ceiling to abutting perimeter walls (Restrained) can result in stress transfer and result in unwanted cracking in the plaster ceiling.
- Lateral Force Bracing (LFB) or seismic struts are not recommended on plaster ceilings.

**Wire Ties and Suspended Ceilings**

At one time wire tying metal supports and metal lath was the most common method of attachment throughout the United States. To make it in the trade, journeymen lathers had to be accomplished and proficient at wire tying. The ability to wire tie with productivity, efficiency and speed is a skill that is appreciated and not quickly mastered. Apprenticeship programs taught the procedure, as they still do today as part of the craft, and when there was an abundance of work requiring wire tying, this allowed the apprentice lather become very proficient with repeated practice.

The advent of screw guns changed everything and wire tying, while still taught, is not nearly as common today as it was a few generations back. Apprenticeship programs for lathers still promote the art of wire tying and training young apprentices to wire tire channels, furring and metal lath is important for us not to lose this skill.

**Why Wire Tie?**

The practice of using a screw gun for attachment and the speed cannot be denied, but there are some advantages to wire tying, particularly when it comes to suspended plaster ceilings. Suspended plaster ceilings have traditionally been wire tied to cold rolled furring and carrying channels and have a long history of successful performance in all areas of the country, even in seismic regions.
CHAPTER 2 - LATH / SUBSTRATES

The suspended ceiling system is the most common commercial ceiling for a rigid plaster and wire tying is the preferred method to attach runners, furring and lath.

Wire Tie Techniques:

BUTTERFLY TIE – Used almost exclusively in attaching metal lath to metal support, this is accomplished by a half twist of the two ends of the tie wire forming wings ½ to ¾ inch long parallel to the direction of the tie, and in opposite directions to each other. Wings must lay tight against lath.

NOTE Where a single strand of No. 16 gage wire is used to form a tie, double strands of No.18 gage shall be allowed in achieving equivalent or greater capacity.

DOUBLE-WRAP TIE – Used in tying spliced metal members such as channels or studs, the double-wrap tie is formed by two complete wraps of a single strand of wire around the spliced members at each end of the splice. The tie is complete with a stub tie.

FIGURE EIGHT TIE – Used in attaching a channel runner to channel brackets. Tie is made at intersection of runner and internal angle of each bracket it crosses to secure the runner to both the vertical and horizontal legs of the bracket. The tie is complete with a stub tie.

SADDLE TIE (A) – Used in tying hanger wire to main runner channels to support a suspended ceiling, the tie is completed by twisting the hanger wire three times around itself. The saddle tie prevents rotation of the channel, and as the tie tightens it holds the channel firmly.

SADDLE TIE (B) - Used in tying cross furring channels to the underside of the main runner channels, and horizontal stiffeners (bridging) in partitions and vertical furring. This type of saddle tie is used to prevent rotation of the furring channel or stiffener. The tie is completed with a stub tie.

STUB TIE (C) – This is the industry name given to the process of completing any light gage wire tie with (minimum) one and one half twists of both ends of the tie wire just prior to cutting the twisted ends. The stub tie may be used to complete any other simple tie where the standard gage tie wire (No. 16 & No. 18) is used.
Earthquake Nailing:

In California, there are additional requirements for the attachment of lath to soffits and ceilings with wood structural framing. The concern is that nails and staples, commonly used to attach lath wood supports, could be worked loose or the lath could tear during a seismic event. The state of California requires lath be attached with a 1 ½ inch long No.9 ring shank hook staple placed around a 10d nail laid flat against the lath surface. The ring shank hook may be used over ribs of 3/8" rib lath or over back wire of wire fabric lath omitting the 10d nails.

Spacing shall be along each support and within three inches of the edge of each sheet of lath, approximately 27 inches. Earthquake nailing is added after standard attachment is complete. This is only required on wood framing, there is no special requirement for attaching lath to steel framing on ceilings. The intent is to increase the surface bearing of the fastener on the lath around the perimeter for a stronger attachment to wood joist.
Suspended Ceilings with Gypsum Wallboard, Cement Board or Fiberglass Faced Gypsum Panels

The ceiling consists of hanger wires attached to the structure above, main runners attached to the hangers, and cross furring attached to the main runners. Panels are screw attached to the furring channel and the joints treated appropriately. This system is suitable for interior or exterior depending on the panels and finish. Standard gypsum panels and veneer plaster systems are common for interior usage. Exterior usage is typically cement panels or fiberglass faced gypsum for a Direct Applied Plaster system (DAS).

Common uses: include the desire for a smooth flat in plane ceiling with a plenum area. This ceiling provides fire protection, concealment and acoustical treatment.

Limitations: the adaptability to complex curved or dome type ceilings. Simple barrel or vault ceilings are possible. Limited access may be provided with the installation of access panels or doors. The access is not equal to lay-in panel type ceilings. Structural design requires no less than 12 gauge wire. Runners and furring should be limited to deflection of 1/360 of the shortest span under the ceiling load. The level of abuse resistance is not equal to suspended plaster ceilings.

Suspended panel ceilings are commonly installed to provide a flat, monolithic ceiling surface at a very economical cost. They can be adapted to several UL fire rated floor/ceiling assemblies, with gypsum panels. Adding acoustical tiles or thin coat acoustical plaster can increase sound absorption qualities.
Direct Applied Systems (DAFS or DEFS)

The Direct Applied System also known as Direct Exterior Finish System (DEFS), is a great option for exterior ceilings. The common assembly is composed of fiberglass-faced gypsum panels, joint treatment and a veneer plaster or a stucco-like finish. These systems are appropriate and have proven very successful for use as an exterior ceiling or soffits, even in wet or high humidity areas. The most common system is with a polymer cement basecoat and mesh covering the panels and an acrylic finish coat. The material costs are more expensive than conventional plaster assemblies but much faster to install. The system is also much lighter in weight at two to three pounds per square foot as opposed to conventional plaster that can weigh ten to twelve pounds per square foot.

Lateral Force Bracing for Plaster/Gypsum Wallboard Ceilings

Most wall and ceiling industry experts caution against installing seismic struts or pods in suspended ceilings that will receive a plaster or gypsum wallboard finish. Two primary reasons have been gained through empirical evidence.

1. The up-lift issue or concern that common with light-weight lay-in type ceilings has not been an issue with heavier ceilings finished with lath and plaster or gypsum wallboard. The concern over lay-in acoustical panels popping out is not a concern with attached finishes. This was clearly evident in the Uniform Building Code as suspended ceilings finished with lath and plaster or gypsum wallboard were clearly exempt from lateral force bracing requirements.

2. The installation of seismic struts or pods (LFB) in suspended ceilings finished with lath and plaster or gypsum wallboard has been done. Unfortunately, cracking has been a problem in many of these installations. The seismic strut can transfer direct pressure or stress from the structure above onto the membrane below. When enough pressure is transferred to a specific point on the ceiling membrane, the ceiling membrane can crack. Even the somewhat flexible gypsum panel will crack with enough pressure concentrated at one specific point.
MASS WALLS (CMU OR CAST-IN PLACE CONCRETE)

Portland cement plaster and concrete masonry share a great affinity. As such, the two materials work very well to form durable, attractive, weather-resistant walls. The use of a fluid-applied or paper-good water-resistive barrier is usually unnecessary and not recommended. The bond between the masonry and the portland cement plaster should be maintained. Chapter 14 of the International Building Code confirms the exception of using water-resistive barriers by stating in section 1403.2.1: “a weather-resistant exterior wall envelope shall not be required over concrete or masonry walls designed and constructed” providing the walls are built per the code.

PREPARATION

- All bases should be straight and in-line with no variation greater than 1/4 inch in 10 feet.
- Surfaces must be cleaned and inspected for any substance that will act as a bond-breaker.
- Concrete masonry units must be fully grouted, "open textured" with joints cut flush, not tooled.
- Substrates should be fully cured, dry and carrying the design dead load prior to the application of the plaster.
- A surface-applied bonding agent conforming to ASTM C 932 may be used to insure a good chemical bond and equalize suction pressure throughout the entire face of the masonry.
- Cast-in-place concrete work: provide sufficient abrasion for a proper mechanical bond with the plaster.
- The plastering contractor must verify the type of bond breaker used prior to direct applying plaster. Sodium silicate bond breakers will dissipate and can be plastered without lath, however, petroleum, oil or paraffin based bond breakers do not dissipate and good bond cannot be guaranteed.
- Apply metal lath when form oil, paint or other bond breaking material is present.
- Overall performance of the plaster can be expected to diminish when the unwarranted use of bond breaking, water-resistive barriers are incorporated into the lathing.

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DIRECT APPLICATION

Apply portland cement plaster to CMU or cast-in-place concrete walls in two coats, consisting of a nominal 3/8 inch basecoat and a 1/8 inch finish coat. Base coat cure times set forth by the IBC (International Building Code) should be followed prior to the application of the finish coat.

The spacing of stress relief joints is less critical than in framed walls. Two-piece expansion joints should be specified where all structural joints occur in the masonry or concrete wall. Additional joints may be required to create a stop/start point where long runs cannot be completed in the course of a typical work day. Corners should be reinforced with welded wire corner aids. Install casing beads at all penetrations and terminations. Foundation weep screeds are not required in masonry work.
CHAPTER 2 - LATH / SUBSTRATES

LATH INSTALLATION

Cement plaster may be applied directly to masonry and/or concrete substrates. When greater thickness or other circumstances deem it necessary for a lath and trim accessories, the following is recommended:

**Design:**
- Masonry/concrete shall be sound and cured a minimum of 28 days prior to attaching lath
- A minimum 2.50 lb/sqy expanded metal lath should be used, furring maybe dimpled or v style.
- A bonding agent may be used to enhance performance
- A Water-Resistant Barrier (sheet goods) is not recommended over masonry/concrete substrates and is not required by code.
  - If additional water-resistance is desired, consider specifying a "crack isolation/reduction" system to reduce the possibility of aesthetic cracking.
- All fasteners shall be corrosion resistant
- Lath shall lap the flange of accessories

**Fasteners:** Fasteners may be one or a combination of the following:

- **Concrete nails** (masonry walls only), 9 gauge with a minimum 3/8 inch head and ¾ inch length.
- **Drive or Strike Pins** must have a minimum ¼ diameter shaft with a mushroom or wide head, and be a minimum ¾ inch in length.
- **Power Actuated Fasteners** minimum ¾ inch long hardened drive style pin, with a ½ inch diameter disc style washer.
- Trim Accessories (excluding casing beads) may be wire tied to lath or mechanically fastened.

**Spacing:** Spacing shall approximate that of framed walls. Basically, a minimum 24 inches on center (horizontal) and 7 inches on center (vertical).

- It is recommended to attach at grout joints, unless the masonry wall is fully grouted.
- All fasteners shall be driven home and engaged the lath to insure secure attachment.

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