Guide to Portland Cement Plastering

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James J. Rose, past Chairman of the Committee and Richard N. Parker were leaders in the plastering industry and they will be greatly missed.

This guide is an update of ACI 524, "Guide to Portland Cement Plastering," which was published in 1964. There are a number of revisions reflecting increased knowledge of plaster and the use of current materials and methods. Recommendations for producing good portland cement-based plaster are described. Various characteristics, procedures, and alternates with advantages and disadvantages are given.

Keywords: accessories; admixtures; application; bases; bond; brown coat; cement; color; cracking (fracturing); curing; fiih coat; furring; masonry; metal lath; mixing; plaster; proportioning; reinforcement; scratch coat; shrinkage; stucco; texture.

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CHAPTER l-PURPOSE OF THE REPORT

l.l-General

This report recommends minimum requirements for satisfactory lathing and plastering. Higher standards, based on long-term and successful field service or controlled laboratory experimentation and documentation, may be set by the designer when the project warrants such treatment.

This report is intended for use by architects/engineers, designers, specification writers, contractors and public authorities concerned with the selection and application of appropriate materials. A glossary of industry plastering terms and their definitions is provided.

This document should not be used as a reference specification number, but the recommendations contained in this report may be useful guidelines for preparing project specifications.

CHAPTER 2-INTRODUCTION

2.1-General

Portland cement plaster is a versatile and weather-resistant surfacing material for either interior or exterior use. Portland cement plaster may be applied to flat, curved' or rusticated bases made from concrete, clay masonry, concrete masonry, and woven, welded, or expanded metal lath.

Portland cement plaster has an excellent history of satisfactory performance in diverse environments. The workability of plaster allows a variety of shapes, designs, and textures. When the plaster hardens, these features are preserved in a rigid permanent form.

The terms "stucco" and "Portland cement plaster" are often used interchangeably. In this report, 'stucco" means plaster applied to exterior surfaces, and 'Portland cement plaster" means plaster applied to interior or exterior surfaces. Both use regular or modified portland cement as the binder.

2.2-Portland cement plaster

Plastering is categorized by the type of cement binder, the number of coats, and the total thickness. The traditional materials include portland cement or blended cement and lime, masonry cement, and plastic cement. Portland cement-based plaster may be applied by hand, or pumped directly from the mixer hopper onto the wall.

2.3-Proprietary exterior wall coatings

Polymeric resins may also be used in the plaster mixture, either as an admixture to modify traditional cementitious binders, or as the primary binder component. Polymer-modified and polymer-based proprietary plaster products are beyond the scope of this report.

2.4-Exterior insulation and finish systems

Exterior insulation and finish systems are exterior wall cladding systems, consisting of an insulation board with an integrally reinforced base coat and a textured protective finish coat.

Portland cement plasters may be used in these systems, but their application and suitability are not covered in this report. They should be examined as a new independent class of products.

CHAPTER 3-DESIRABLE PROPERTIES OF PLASTER

3.1-General

Portland cement plaster must have certain properties in both the fresh and hardened state to allow proper application and long-term service. A properly mixed plaster can be either hand or machine applied. Freshly mixed plaster should have good adhesion and cohesion characteristics and should remain workable long enough to obtain the desired surface. Hardened plaster should be weather resistant, durable, and should provide the specified appearance criteria (color and texture).

3.2-Fresh plaster

Fresh plaster should have the following properties:

3.2.1 *Adhesion*-The capability to adhere or stick to a substrate is developed in the plaster by the combination of materials and application technique. Adhesion is influenced by aggregate, water-cement ratio, and the absorptive characteristics of the base.

3.2.2 *Cohesion*-The ability of plaster to cohere or stick to itself is affected by the portland cement paste; particle size, shape and gradation; and quantity of aggregate and water. A cohesive plaster will remain in place without sagging, sloughing, or delaminating.

3.23 *Workability*-Workability is the ease with which the plaster is placed, shaped, floated, and tooled. Workability involves adhesion, cohesion, weight, and spreadability. To give the best workability, all materials should be proportioned properly and combined during mixing. Plaster with poor workability requires greater effort to apply, increases costs, and may result in an appreciable impairment in the desired hardened properties of hardened material.

3.3-Hardened plaster

Finished, hardened plaster should have the following characteristics:

3.3.1 *Weather resistance*-The ability of plaster to withstand weathering includes resistance to wind and rain penetration, resistance to freezing and thawing, and resistance to thermal and moisture changes. Resistance to aggressive chemicals in the atmosphere, such as acid rain, is also of concern.

3.3.2 *Freezing and thawing resistance*-The use of air-entrained plaster is beneficial especially where snow or deicing chemicals may come into contact with a plastered surface.

3.3.3 *Sulfate resistance*-**In aggressive sulfate environ**ments, additional resistance to sulfate may be obtained with the use of Type II or Type V portland cement, or masonry cement. A suitable mineral admixture, as defined in ACI 201, "Guide to Durable Concrete," may also be used in combination with Type I or Type II portland cement.

Additional precautions may include application of a water-resistant surface coating or penetrating sealer applied to plaster below grade, or plaster should be terminated 6 in. above grade.

3.3.4 *Bond*-Bond is the adhesion between similar or dissimilar materials. Bonding between one plaster coat and another is the result of chemical bonding, mechanical keying, or a combination.

3.3.5 *Tensile strength*-High tensile strength increases the ability of plaster to resist cracking. Proper curing of a well-proportioned and consolidated plaster is critical to obtaining optimum crack resistance.

CHAPTER 4-PORTLAND CEMENT PLASTER MATERIALS

4.1-General

Materials should comply with building codes and job specifications.

Packaged materials should be labeled properly, indicating the manufacturer, brand name, and recommendations for use.

Packaged materials that might be damaged by moisture should be protected. Proprietary or specialty plaster should be mixed in accordance with the manufacturer's recommendations.

4.2-Cements

The cement may consist of any of the following types: portland cement, conforming to ASTM C 150 (gray or white), type as required.

Blended cement, conforming to ASTM C 595, type as required. Sulfate-resistant cements, masonry cements, or mineral admixtures should be used where sulfate soil or ground water conditions exist.

Low-alkali cements conforming to ASTM C 150 or blended cements conforming to ASTM C 595 should be used with potentially reactive aggregates. Alternatively, suitable combinations of cement and mineral admixtures may be necessary.

Masonry cement conforming to ASTM C 91, Types N, S, and M.

Plastic cement conforming to the requirements of UBC Standard Chapter 47 or ASTM C 926.

Air-entraining cements may be used where available.

4.3-Lime

Use Type S, special hydrated lime conforming to

ASTM C 206 or C 207. Air-entraining limes may also be used where available.

4.4-Aggregates

The aggregates may be either natural or manufactured sand conforming to ASTM C 897 or lightweight perlite or vermiculite aggregate conforming to ASTM C 35, Table No. 1.

Conventional portland cement plaster should not be applied to base coats containing perlite or vermiculite.

Portland cement plaster containing perlite or vermiculite aggregates has low resistance to effects of freezing and thawing.

When ASTM C 897 aggregates are not available, ASTM C 144 aggregates may be substituted.

The use of substandard aggregates may increase the water demand, resulting in a weaker mix with poor durability and a greater tendency toward cracking. Aggregates that are frozen should not be used.

4.5-Water

Potable water is generally acceptable. The water used in mixing and for curing portland cement plaster should be clean and free from injurious amounts of oil, acid, alkali, organic matter, salts, or other deleterious substances. Such substances may impair the setting and hardening characteristics of the plaster, or stain or discolor the surface.

4.6-Admixtures

The following admixtures may be added provided they are accepted in the project specifications.

4.6.1 *Air-entraining admixtures*-Air-entraining admixtures conforming to ASTM C 260 reduce water demand, absorption, or water penetration while improving workability and resistance to freezing and thawing.

Air-entraining admixtures should be pretested when used with air-entraining cements or limes. Household-type detergents should not be substituted for appropriate air-entraining admixtures.

4.6.2 *Calcium chloride*-Calcium chloride should conform to ASTM D 98. Caution should be exercised in the use of calcium chloride as an accelerator. The flake form should be put into solution prior to being added to the plaster mixture.

Calcium chloride or accelerating admixtures containing significant amounts of calcium chloride should not be used when portland cement plaster will come into contact with metal lath, anodized aluminum, galvanized steel, or zinc accessory products. Chloride ions may accelerate the corrosion of such metals, causing expansion within the portland cement plaster resulting in cracking.

Noncorrosive accelerating admixtures meeting ASTM C 494 are recommended when needed.

4.6.3 *Chemical admixtures*-Water-reducing admixtures and water-reducing/set retarding or accelerating admixtures conforming to ASTM C 494 may be used to reduce the water-cement ratio of portland cement plaster.

Manufacturer's recommendations should be observed in the use of chemical admixtures. Very small changes in quantities may have a significant effect on the properties of portland cement plaster.

4.6.4 *Water repellent admixtures*-Stearate emulsions, in amounts not to exceed 2 percent by weight of cement, may be used to improve water repellency and decrease absorption. Some of these emulsions may also entrain air. The use of stearates may reduce bond between coats and may degrade with time.

4.6.5 *Pigments*-Coloring agents should be of uniform color, free of lumps, and conform to ASTM C 979. To avoid strength reductions, the pigment content should not exceed 10 percent of the weight of the cement. Only mineral pigments should be used as coloring agents. The use of lamp black or carbon is not recommended.

4.6.6 *Other admixtures and additives*-Bentonite or other clays, diatomaceous earth, pozzolans, and the plasticizers are used in plaster to improve workability. Fly ash and other mineral co-mixtures may be added to plaster to improve sulfate resistance. Bonding agents and other additives are used to improve other characteristics of plaster. Manufacturer's recommendations should be observed.

4.7-Fibers

When accepted by the project specifications, fibers conforming to ASTM C 1116 may be used. If glass fibers are used, it is important that they are alkali resistant. The use of these fibers generally improves cohesiveness, crack resistance, impact resistance, and resistance to water penetration. Fibers should be added to the mix in the manner and amount recommended by the manufacturer.

4.8-Bonding agents

Bonding agents permit direct application of plasters to clean, structurally sound surfaces such as concrete, brick, and concrete masonry units. There are two types of bonding agents: surface applied and integrally mixed.

4.8.1 *Surface applied bonding agents*-Surface applied bonding agents are single-component, ready-to-use liquids, which are applied to the surface by brush, roller, or spray. Surface-applied bonding agents should conform to the requirements of ASTM C 631 for interior plaster or C 932 for exterior plaster. Refer to the manufacturer's recommendations for specific application directions.

4.8.2 *Integral bonding agents*-Integral bonding agents are acrylic, styrene-butadiene, or latex polymers, generally diluted with water at the jobsite, and added to the plaster mix to promote bond.

CHAPTER 5-METAL PLASTER BASES

5.1-General

There are three commonly used metal plaster bases:

1. Expanded metal lath diamond mesh (see Fig. 5.1) or rib lath (see Fig. ***5.2).***

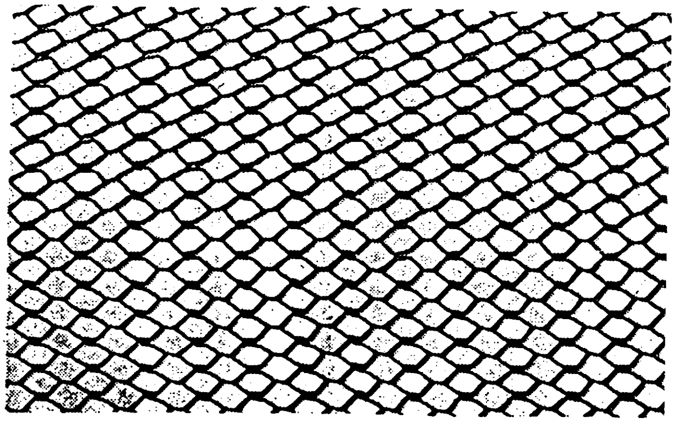

Fig. 5.1-Diamond mesh lath

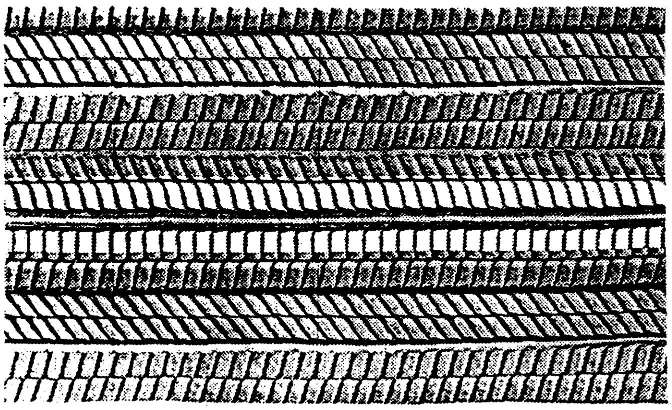

Fig. 5.2—3/8-in. rib lath

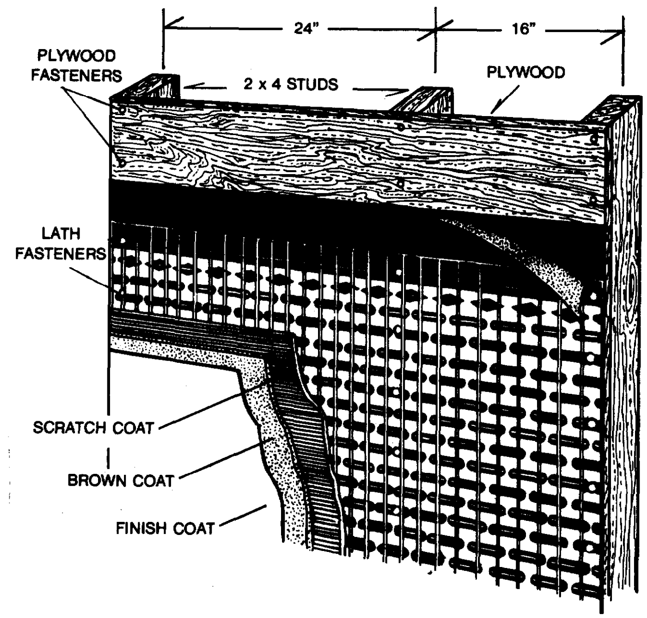

Fig. 5.4-Welded wire (Photo courtesy of K-Lath, Monrovia, CA)

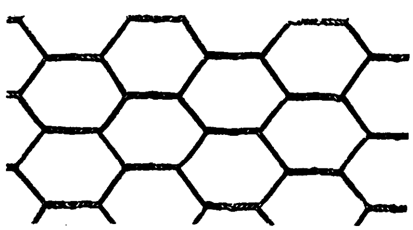

Fig. 5.3-Woven wire (Courtesy of K-Lath, Monrovia, CA)

2. Woven wire plaster base (see Fig. 5.3).
3. Welded wire lath (see Fig. 5.4).

5.1.1 *Expanded metal lath (ASTM C 841, C 847, C 1063)*-Expanded metal lath is fabricated from coils of steel that are slit and then expanded, forming a diamond pattern. Expanded metal lath is available in flat, self-furred and rib style, with or without weather barrier backing.

Finished sheets are 27 in. wide by 96 in. long. The weight is determined by the thickness (gage) of the base steel. Nominal weights are 1.75, 2.5, 3.4, and 4.0 lb/yd^2.

Metal lath intended for interior use only, should be coated with a corrosion-resistant film: asphalt, non-re-emulsifiable water base paint, or an electroplated galvanizing. Galvanized metal lath intended for exterior application should have a G-60 coating in accordance with ASTM A 525 (hot dip process).

5.1.2 *Woven wire plaster base (ASTM C 841, C 1032, C 1063)*-Woven wire plaster base, flat or self-furred, is fabricated from galvanized steel wire by the reverse twist method into hexagonal mesh patterned rolls or sheets. It may be fabricated with or without stiffener wire backing.

The minimum wire diameter for the size of the openings is 20 gage (0.86 lb/yd^2) for 1 in., 17 gage (1.4 lb/yd^2) for $1^1/_2$ in., and 16 gage (2.02 lb/yd^2) for 2 in.

The width of woven wire plaster base is a minimum of 34 and one-half in. Flat sheets are a minimum of 100 in. long. Rolls without backing are 150 ft long. Rolls with backing are 100 ft long. Paper backing must never overlap lath.

5.13 *Welded wire lath (ASTM C 841, C 933, C 1063)*---Welded wire lath, flat or self-furred, with or without backing, is fabricated from not less than 15 gage (0.0625 in.) copper-bearing, cold-drawn galvanized steel wire conforming to ASTM A 641. The wire is welded into an intersecting grid pattern forming openings not more than 2 in. in either direction. Stiffener wires of 14 gage are installed not over 6 in. on center parallel to the long dimension of the sheets. Sheets are nominally 28 in. wide by 96 in. long and weigh 1.14 lb/yd^2.

5.2-Weather barrier backing

5.2.1 *Factory attached backing*-Most metal reinforcement is available with attached backing. The weather-resistive material may be netting, film, kraft paper, impregnated kraft paper, or felt. It is attached at the factory to prevent accidental removal during shipment, handling, or installation.

Federal Specification UU-B-790a differentiates weather-resistive kraft papers by water resistance, vapor permeability, and tensile strength. The water-resistant barrier should consist of at least two layers of minimum Grade D paper over plywood sheathing, one layer over other sheathing products, or as otherwise required by local codes. Whether the paper is applied by the manufacturer or at the jobsite, it is recommended that a weather barrier equivalent to asphalt-saturated kraft paper or rag felt be installed behind the lath. Such paper should be applied weather board fashion, lapped not less than 2 in. at horizontal joints, and not less than 6 in. at vertical joints.

Grade A paper should resist water penetration for 24 hr, and Grade B paper should resist water penetration for 16 hr. Grade D, 60-min paper, should resist water penetration for 1 hr. Grade D, 10-min paper, should resist water penetration for 1/6 hr.

Grade A and Grade B papers, polyethylene fibrous fabric and polyethylene film, are vapor retarders and should be used with caution in cold areas. Grade D paper allows for vapor permeability at a rate of 35 perms minimum in 24 hr. It is desirable in many types of construction to allow trapped moisture to escape from the wall cavity.

CHAPTER 6-LATHING ACCESSORIES

6.1-General

Properly designed and installed accessories can contribute significantly to improved plaster work. Accessories establish plaster grounds and transfer stresses in critical areas of plaster elements.

Environmental or climatic conditions may determine the type of accessories that should be used. Accessories are fabricated from various types of metals or polyvinyl chloride (PVC). Some manufacturers produce sections of stainless steel for special applications. Zinc alloy or plastic accessories should be used in exterior work where corrosion is a concern, such as in coastal regions and heavy industrial areas.

Plastic (PVC) can be used in most weather conditions but should not be used where extreme variations in temperature are expected. Some PVC may break down when exposed to ultraviolet or chemical attack. Only PVC manufactured to resist ultraviolet and or chemical attack should be used. ASTM C 1063 has established minimum thicknesses for accessories, as shown in Table 6.1.

Table 6.1-Minimum thickness of accessories by base material, in. (mm) (ASTM C 1063, Table 3)

Accessory	Steel	Zinc alloy	P.V.C
Corner beads Casing beads	0.0172 (0.44)	0.0207 (0.53)	0.035 (0.89)
Drip screeds	0.0225 (0.57)	0.024 (0.61)	**0.050 (1.27)**
Control joints	0.0172 (0.44)	0.018 (0.46)	0.050 (1.27)

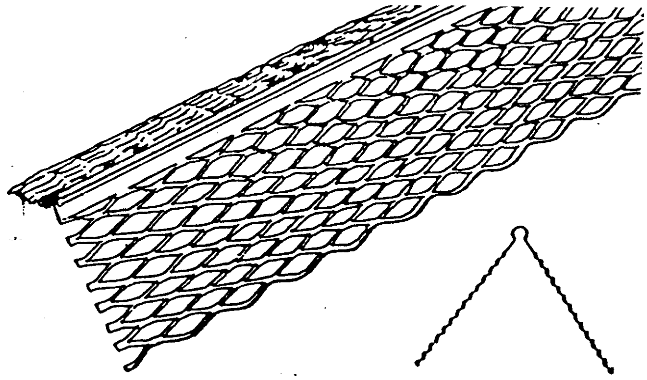

Fig. 6.1-Corner bead (Courtesy of Alabama Metal Industries Co., Birmingham, AL)

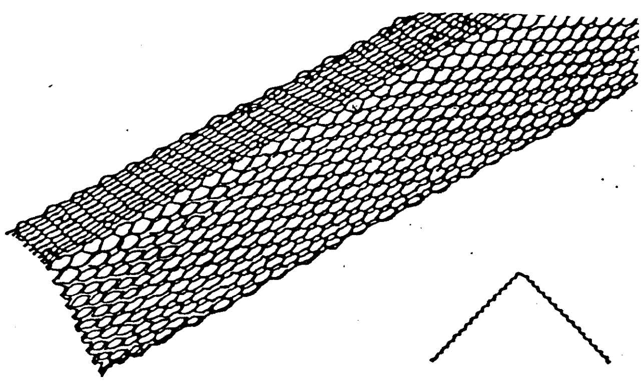

Fig. 6.2-Corner lath (Courtesy of Alabama Metal Industries Co., Birmingham, AL)

6.2-Corner reinforcements

External corner (arris) reinforcements are manufactured from galvanized steel, zinc alloy, and vinyl. They may be expanded flange corner beads (see Fig. 6.1), welded or woven steel wire (minimum No. 18 gage), vinyl bead, or expanded metal corner lath (see Fig. 6.2). They

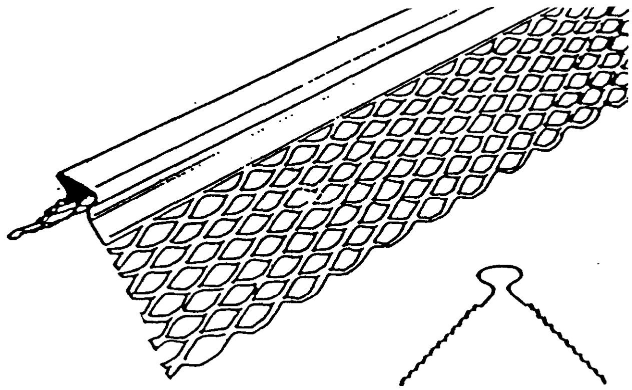

Fig. 6.3-Bull nose corner (Courtesy of Alabama Metal Industries Co., Birmingham, AL,)

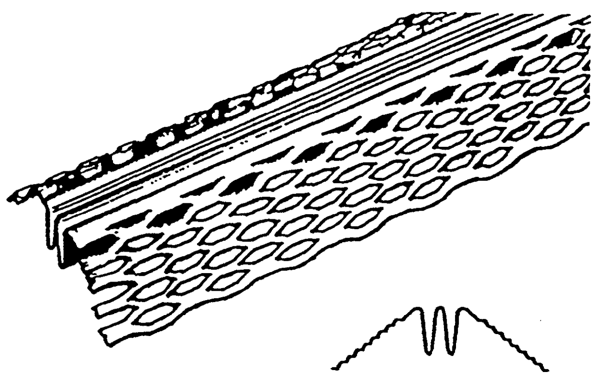

Fig. 6.4-Inside corner joint (Courtesy of Alabama Metal Industries Co., Birmingham, AL)

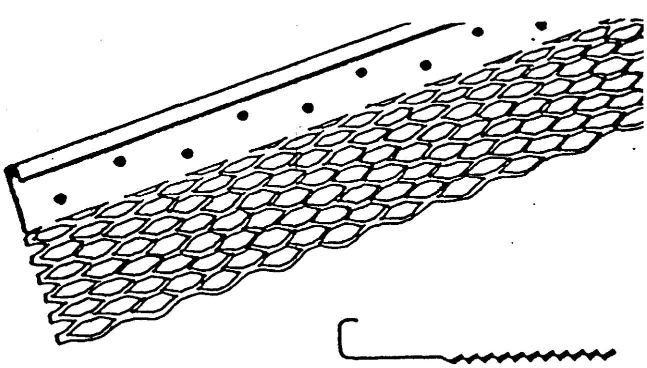

Fig. 6.5-Casing beads (Courtesy of Alabama Metal Industries Co., Birmingham, AL)

are made of galvanized steel, zinc alloy, or treated to provide corrosion resistance. The corner reinforcement must be of a design that allows plaster to be applied without hollow areas.

For bullnose plaster corner construction, a bullnose corner reinforcement, or a 6-in. minimum wide strip of expanded metal or wire lath may be installed on the corner (see Fig. 6.3).

6.3-Inside corner joint

The inside corner joint is an accessory designed to provide stress relief at internal angles (see Fig. 6.4).

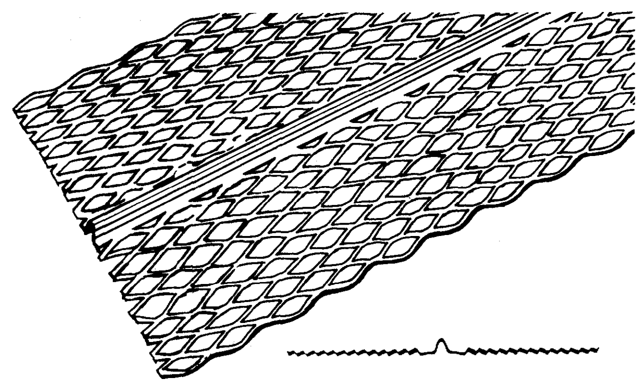

Fig. 6.6-Base screed (Courtesy of Alabama Metal Industries Co., Birmingham, AL)

6.4-Casing beads

Often called plaster stops, casing beads should be installed wherever plaster terminates or abuts with dissimilar material. Casing beads are manufactured with solid flanges and expanded flanges. Short flange casing beads are nailed or screwed to framing members, while expanded flange casing beads are usually wire-tied to metal plaster base. They are formed from 26-gage galvanized steel with flanges to establish one-half, three-quarter, one, one and one-eighth, and one and one-quarter in. grounds with either a 90 or 45-deg return (see Fig. 6.5).

6.5-Screeds

Plaster screeds (see Fig. 6.6) establish plaster thickness or create decorative motifs. To separate portland cement plaster from gypsum plaster, concrete, or terrazzo, a base screed, also called a parting screed, is often installed.

They are usually manufactured from 26-gage galvanized steel in 10-ft lengths. Base screeds are designed to provide one-half in. plaster grounds, but they may be installed to accommodate other grounds. Screeds should never be used as stress relief joints.

Screeds used to provide decorative reveals in plaster are available in a variety of sizes and are formed from galvanized steel, zinc alloy, extruded anodized aluminum, and extruded polyvinyl chloride.

6.5.1 *Ventilating screeds*-Ventilating screeds (see Fig. 6.7) have perforated webs to allow free passage of air from the outside; this is common for exterior soffits. They also establish grounds for plaster thickness and prevent water from running from vertical surfaces to horizontal surfaces.

6.5.2 *Drip screeds*-Soffit drip screeds (see Fig. 6.8) are installed in exterior plaster ceilings to prevent water that has run down the face of a structure from returning to plaster soffits and the ceiling.

6.5.3 *Weep screeds*-Foundation weep screeds (see Fig. 6.9) are required by most building codes and are installed at the foundation plate line (or mud-sill). They are lo-

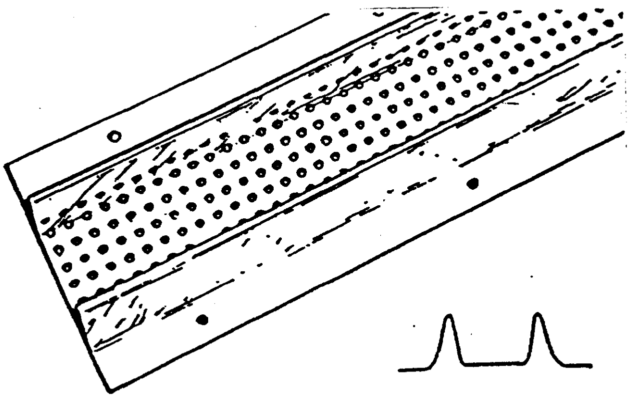

Fig. 6.7-Soffit vent screed (Courtesy of Alabama Metal Industries, Birmingham, AL)

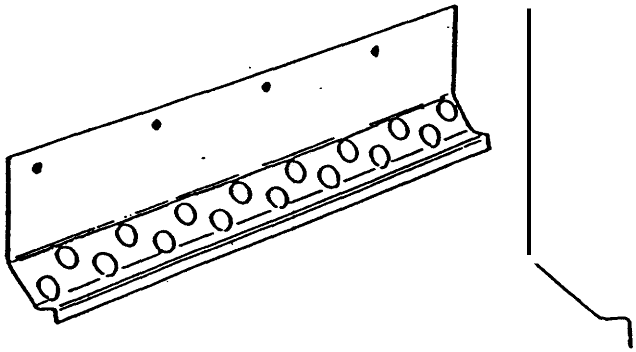

Fig. 6.8-Drip mold(Courtesy of Alabama Metal Industries, Birmingham,AL)

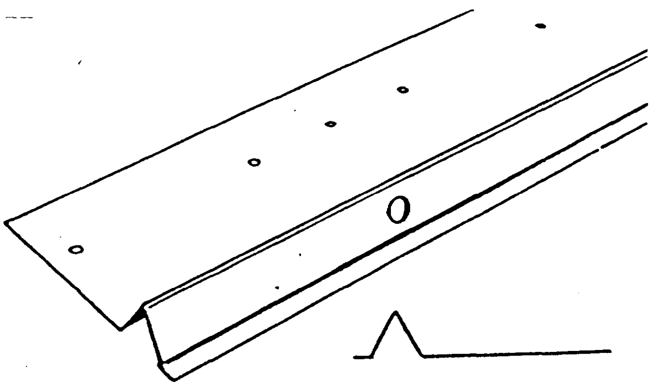

Fig. 6.9-Foundation screed (Courtesy of Alabama Metal Industries, Birmingham, AL)

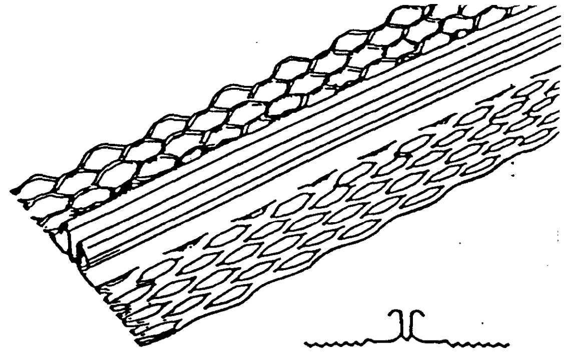

Fig. 6.10-Expansion control joint (Courtesy of Alabama Metal Industries Co., Birmingham, AL)

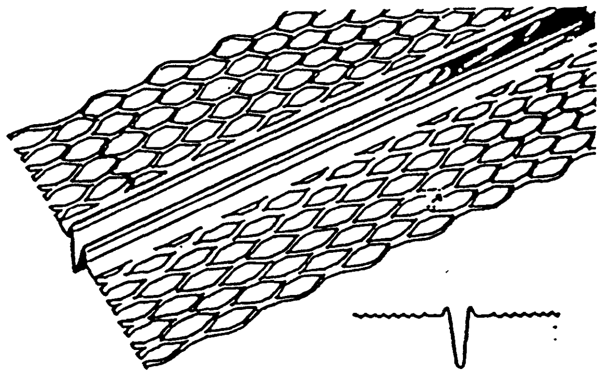

Fig. 6.11-Deep groove (Courtesy of Alabama Metal Industries Co., Birmingham, AL)

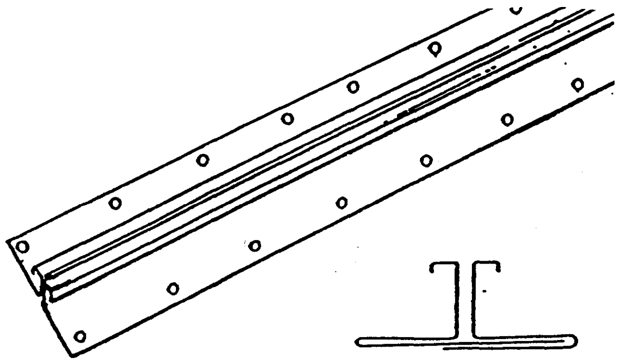

Fig. 6.12-Two-piece expansion joint (Courtesy of Alabama Metal Industries Co., Birmingham, AL)

cated no lower than 4 in. from the finished grade. This accessory functions as a plaster stop and allows trapped moisture to escape from the space between the backing paper and plaster.

6.5.4 *Decorative screeds*-Decorative screeds include reveals for corners, angles, and intersecting sections.

6.6-Control joints

Control joints are designed to relieve stress concentrations in plaster, and thus minimize cracking. Control joints are manufactured using galvanized steel, zinc alloy, anodized aluminum, and plastic (polyvinyl chloride). Special control joints may be fabricated using stainless steel.

Galvanized steel is the most extensively used formed section material. Galvanized steel, as a general rule, should not be used in areas where chemical, ocean spray, or frequent moisture exposure is expected.

Zinc alloy can be used for service in almost any weather condition. However, because it is a less rigid material, greater care is required during installation-to insure proper alignment (see Fig. 6.10-6.13).

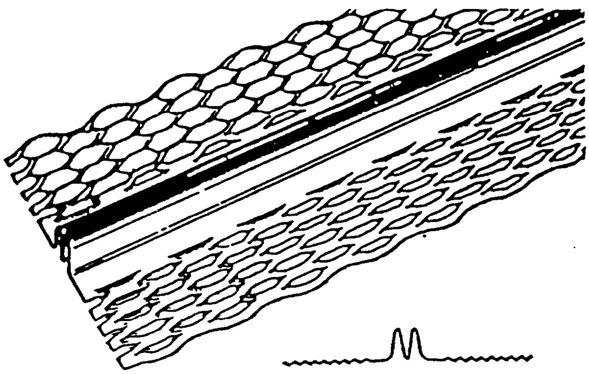

Fig. 6.13-Expansion joint (Courtesy of Alabama Metal Industries Co., Birmingham, AL)

CHAPTER 7-DESIGN CONSIDERATIONS FOR PORTLAND CEMENT PLASTERING

7.1-General

Lath and plaster may be applied over open framing, framing with sheathing, masonry, or monolithic concrete. The properties of each individual substrate must be evaluated to achieve quality portland cement plaster work.

Open framing may consist of conventional wood or metal studs. Wood studs that are not kiln dry may contain as much as 19 percent moisture. Wood with this degree of saturation may shrink and distort as it dries, resulting in deformation and cracking in the plaster. Wood studs and wood sheathing should be protected from wetting during jobsite storage. Open-frame construction is subject to variation in plaster thickness and increasing the potential for cracking. Line wire should be installed to support paper backing and lath. Whenever rounded corners are desired, the edges of wood studs and beams should be chamfered to a 45-deg angle, enabling a full thickness of plaster at corners to reduce stresses.

Steel stud framing expands and contracts with temperature changes. Control joints should be located at anticipated points of stress concentration.

7.2-Design criteria for ceilings

Non-bearing walls and ceilings should be constructed without attachment to the main structure to prevent the transfer of movement or vibration. Allowances should be made for deflection of overhead beams and slabs. By properly locating hangers, ceiling channels supporting lath and plaster should be kept free from abutting walls. Various codes and standards have established design criteria for ceilings. Criteria established in ASTM C 1063 are shown in Table 7.1.

7.3-Design criteria for supports

Because metal plaster bases are made in different weights (per yd^2) and styles, building codes and other regulations stipulate the maximum allowable span for each. ASTM C 1063 is the primary reference on this subject (see Table 7.2). The established criteria of the Uniform Building code are shown in Table 7.3.

Some manufacturers have tested their products on support spacings greater than those shown in these references. As a result, approvals by model or local building codes have been granted for longer spans.

In addition to stating maximum allowable support spacings, ASTM C 1063 and various building codes specify types of fasteners and their location for the various types of lath. The criteria established by the Uniform Building Code is shown in Table 7.4.

7.3.1 *Sheathing*-Uniform plaster thickness is obtained more readily when open framing is covered with a solid sheathing such as exterior gypsum, insulation board, expanded polystyrene, or wood.

Plywood sheathing should be installed with a minimum **⅛-in.** clearance on all sides to allow for expansion in case the plywood gets damp.

Any absorbent sheathing board should have an additional layer of water-resistant building paper under paper-backed metal bases to prevent absorption of moisture from the plaster.

7.3.2 *Control joints/stress relief*-Control joints are required when plaster is applied over a metal base. Control joints divide or limit the size of the plaster panel and provide relief from stress. Control joints may be established by several methods:

1. Scoring or cutting the plaster surface or intersection.
2. Grooving plaster by installing a temporary ground, removing the ground, and then filling the groove with a caulking material.
3. Insertion of a formed metal or plastic section which allows for expansion or contraction of the abutting plaster.

Scoring as a stress relief mechanism consists of partially severing the plaster membrane. Cutting implies a total separation of the wall assembly including both lath and plaster. Cutting is considered to be the more effective method.

Grooves may be formed by plastering to a temporary ground, and then removing the ground when the plaster has attained sufficient strength. Grooves formed in this manner should be caulked to make the joint weather resistant.

A weather-resistant barrier should continue unbroken behind the control joint and should be shingle-lapped to the paper backing of the lath. Joints, intersections, and terminations of control joints, should be embedded and weather-sealed.

There is no generally accepted standard for the maximum plaster area that may be placed safely between control joints. A conservative recommendation is a maximum of 10 ft on center. A liberal recommendation is 18 ft on center.

Another recommendation is that spacing of control joints on typical construction is to produce panels of from 100 to 144 square feet (in as square a configuration

Table 7.1-Suspended and furred ceilings minimum sizes for wire, rod, and rigid hangers; minimum sizes and maximum spans and spacings for main runners; and minimum sizes and spacings for cross furring (ASTM C 1063, Table 1)

	Hangers	
	Maximum ceiling area suppported, ft^2	Minimum size of hangers, in.
Hangers for suspended ceilings	12.5	0.1483 wire
	16	0.1620 wire
	18	3/16 in. diameter, mild steel rod[A]
	20	7/32 in. diameter, mild steel rod[A]
	22.5	1/4 in. diameter, mild steel rod[A]
	2.50	1 by 3/16 in. mild steel strap[B]
Attachments for tying runners and furring directly to beams and joists:		
For supporting runners:		
Single hangers between beams[c]	8	0.1055 wire
	12	0.1350 wire
	16	0.1620 wire
Double wire loops at beams or joists[c]	8	0.0800 wire
	12	0.1055 wire
	16	0.1205 wire
For supporting furring without runners[c] (wire loops at supports):		
Types of support:		
Concrete	8	0.0800 wire
Steel	8	0.0625 (2 loops)[D]
Wood	8	0.0325 (2 loops)[D]
Spans and spacings of main runners[E,F]		
Minimum size and type	Maximum span between hangers or support, in.	Maximum center-to-center spacing of runners, in.
3/4 in. — 0.3 lb/ft, cold or hot-rolled channel	24	36
1 1/2 in. — 0.475 lb/ft, cold-rolled channel	36	48
1 1/2 in. — 0.475 lb/ft, cold-rolled channel	42	42
1 1/2 in. — 0.475 Ib/ft, cold-rolled channel	48	36
1 1/2 in. — 1.12 lb/ft, hot-rolled channel	48	54
2 in. — 0.59 lb/ft, cold-rolled channel	60	48
2 in. — 1.26 Ib/ft, hot-rolled channel	60	60
1 1/2 in. — 1 1/2 in. by 3/16 in. angle	60	42
Spans and spacings of cross furring[E,F]		
Minimum size and type	Maximum span between runners or supports, in.	Maximum center-to-center spacing of cross furring members, in.
1/4 in. diameter pencil rods	24	12
3/8 in. diameter pencil rods	24	19
3/8 in. diameter pencil rods	30	12
3/4 in. — 0.3 lb/ft, cold or hot-rolled channel	36	24
	42	19
	48	16
	48	24
1 in. — 0.410 lb/ft, hot-rolled channel	54	19
	60	12

[A] It is highly recommended that all rod hangers be protected with a zinc or cadmium coating.
[B] It is highly recommended that all flat hangers be protected with a zinc or cadmium coating or with a rust-protective paint.
[C] Inserts, special clips, or other devices of equal strength may be substituted for those specified.
[D] Two loops of 0.0475-in. wire may be substituted for each loop of 0.0625-in. wire for attaching steel furring to steel or wood joists.
[E] These spans are based on webs of channels being erected and maintained in a vertical position.
[F] Other sections of hot- or cold-rolled members of equivalent beam strength may be substituted for these specified.

as possible). One dimension of a panel should not exceed 2-1/2 times the other dimension.

The coarseness of the finish coat texture should also be considered. Cracks are not as apparent in heavy coarse textures as they are in fine or smooth textures. Closer joint spacing is recommended with finer textures.

The designer should show the selected location of contraction and expansion joints in detail on the contract drawing elevations. They should be located as near as possible to points or lines of weakened structural planes. Some locations that consistently crack are:

1. Header and sill corners of windows, doors, or other penetrations of the plaster skin.
2. Edges and corners of heating or ventilation vents.

Table 7.2-Type and weights of metal plaster bases and corresponding maximum permissible spacing of supports (ASTM C 1063, Table 2)

Type of metal plaster base	Minimum weight of metal plaster base, lb/yd^2 (kg/m^2)	Maximum permissible spacing of supports center to center, in. (mm)				
		Walls (partitions)			Ceilings	
		Wood studs or furring	Solid partitions[A]	Steel studs or furring	Wood or concrete	Metal
U.S. nominal weights:						
Diamond mesh[D]	2.5 (1.4)	16 (406)[C]	16(406)	16(406)[C]	12 (305)	12(305)
	3.4 (1.8)	16 (406)[C]	16(406)	16(406)[C]	16 (406)	16(406)
Flat rib	2.75(1.5)	16 (406)	16(406)	16(406)	16 (406)	16(406)
	3.4 (1.8)	19 (402)	24(610)	19 (482)	19 (482)	19(462)
$^3/_4$ in. rib	3.4 (1.6)	24(610)	N/A[B]	24 (619)	24 (610)	24(610)
	4.0 (2.1)	24(610)	N/A	24(610)	24 (610)	24(610)
$^3/_4$ in. rib	5.4 (2.9)	24(610)	N/A	24(610)	36 (914)	36(914)
sheet	4.5 (2.4)	24(610)	N/A	24(610)	24 (610)	24(610)
Welded wire[D]	1.4 (0.8)	16(406)	16 (406)	16(406)	16 (406)	16(406)
	1.95 (1.1)	24 (610)	24(610)	24 (610)	24 (610)	24(610)
Woven wire[D]	1.1 (0.6)	24(610)	16(406)	16 (406)	16 (406)	24(610)
	1.4 (0.6)	24(610)	16(406)	16(406)	24 (610)	16(406)
Canadian nominal weights:						
Diamond Mesh[D]	**2.5 (1.4)**	16 (406)	12 (305)	12(305)	12(305)	12(305)
	3.0 (1.6)	16 (406)	12 (305)	12(305)	12(305)	12(305)
	3.4 (1.8)	16 (406)	16 (406)	16(406)	16(406)	16(406)
Flat rib	**2.5 (1.4)**	16(406)	12 (305)	12(305)	12(305)	12(305)
	3.0 (1.6)	16(406)	16 (406)	16(406)	16(406)	13-$^1/_2$
¾ in. rib	**3.0 (1.6)**	19(482)	N/A	16(406)	16(406)	16(406)
	3.5 (1.9)	24(610)	N/A	19(482)	19(482)	19(462)
	4.0 (2.1)	24 (610)	N/A	24(610)	24(610)	24(610)

[A] Where lath with backing is used, backing shall be absorbent and slotted paper.
[B] Not applicable.
[C] These spacings are based on unsheathed walls. Where self-furring lath is placed over sheathing or a solid surface, the permissible spacing of supports may be increased to 24 in.
[D] Metal plaster bases shall be furred away from vertical supports or solid surfaces at least ¼ in. Self-furring lath meets furring requirements; except, furring of expanded metal lath is not required on supports having a bearing surface of 1⅝ in. or less.

Table 7.3-Types of lath-maximum spacing of supports (UBC Table No. 47-B[1])*

Type of lath[2]	Minimum weight of (per yd^2) gauge and mesh size	Vertical (in inches)			Horizontal (in inches)	
		Wood	Metal			
			Solid plaster partitions	Other	Wood or concrete	Metal
1. Expanded metal lath (diamond mesh)	**2.5**	**16[3]**	**16[3]**	**12**	**12**	**12**
	3.4	**16[3]**	**16[3]**	**16**	**16**	**16**
2.Flat rib expanded metal lath	**2.75**	**16**	**16**	**16**	**16**	**16**
	3.4	**19**	**24**	**19**	**19**	**19**
3. Stucco mesh expanded metal lath	**1.8 and 3.6**	**16[4]**	**—**	**—**	**—**	**—**
4. $^3/_8$ in. rib expanded metal lath	**3.4**	**24**	**24[5]**	**24**	**24**	**24**
	4.0	**24**	**24[5]**	**24**	**24**	**24**
5. sheet lath	**4.5**	**24**	**5**	**24**	**24**	**24**
6. Win fabric lath — Welded	**1.95 lb, No. 11 2 in. x 2 in.**	**24**	**24**	**24**	**24**	**24**
	1.16 lb, No. 16 2 in x 2 in.	**16**	**16**	**16**	**16**	**16**
	1.4 lb, No. 18 1 in. x 1 in.[6]	**16[4]**			**—**	**—**
Woven[4]	**1.1 lb, No. 18, 1$^1/_2$ in. hexagonal[6]**	**24**	**16**	**16**	**24**	**16**
	1.4 lb, No. 17, 1$^1/_2$ in. hexagonal[6]	**24**	**16**	**16**	**24**	**16**
	1.1 lb, No. 18.1$^1/_2$ in. hexagonal[6]	**24**	**16**	**16**	**24**	**16**

1 For fire-resistive construction, see Table No. 43-A, 43-B and 43-C. For shear-resisting elements, see Table No. 47-1.
2 Metal lath and wire fabric lath used as reinforcemen t for portland cement plasterr shall be furred out away from vertical supports at least 1/4 inch. Self furring lath meets furring requirements. Exception: Furring of expanded metal lat is not required on supports having a bearing surface width of 1$^5/_8$ in. or less
3 Span may be increased to 24 inches with self-furred metal lath oer solid sheathing assemblies approved for this use.
4 Wire backing required on open vertical frame construction except under expanded metal lath andpaperbacked wire fabric lath.
5 May be used for studless solid partitions.
6 Woven wire or welded wire fabric lath, not to be used as base for the gypsum plaster without absorbent paperbacking or slot-perforated separator.

Table 7.4-Types of lath-attachment to wood and metal[1] supports (UBC Table No. 47-C)*

	Nails[2,3]			Screws[3,6]		Staples[3,4] -- Round or flattened wire				
Type of lath	Type and size	Maximum spacing[6] (in inches)		Max. spacing[6] (in inches)		Wire gage No.	Crown	Leg[7]	Max. spacing[5]	
		Vertical	Horizontal	Vertical	Horizontal		(in inches)		Vertical	Horizontal
1. Diamond mesh expanded metal lath and flat rib metal lath	4d blued smooth box 1½ in.[11] No. 14 gage 7/32 in. head (clinched)[8] 1 in. No. 11 gage 7/16 in. head, barbed 1½ in. No. 11 gage 7/16 in. head, barbed	6 6 6	— — 6	6	6	16	¾	⅞	6	6
2. ⅜" rib metal lath and sheet lath	1½ in. No. 11 gage 7/16 in. head, barbed	6	6	6	6	16	¾	1¼	At ribs	At ribs
3. ¾" rib metal lath	4d common 1½ in. No. 12½ gage ¼ in. head 2 in. No. 11 gage 7/16 in. head, barbed	At ribs	At ribs	At ribs	At ribs	16	¾	1⅝	At ribs	At ribs
4. Wire fabric lath[9]	4d blued smooth box (clinched)8 1 in. No. 11 gage 7/16 in. head, barbed 1½ in. No. 11 gage 7/16 in. head, barbed 1¼ in. No. 12 gage ½ in. head, furring 1 in No. 12 gage ½ in. head	6 6 6 6 6	6 6	6	6	16 16	¾ 7/16 in.	⅞ ⅞	6 6	6 6
5. ⅞ in. gypsum lath	1⅛ in. No. 13 gage 19/64 in. head, blued	8[10]	8[10]	8[10]	8[10]	16	¾	⅞	8[10]	8[10]
6. ½ in. gypsum lath	1½ in. No. 13 gage 19/64 in. head, blued	8	8[10] 6[11]	810	8[10] 6[11]	16	¾	1⅛	8[10]	8[10] 6[11]

[1] Metal lath, wire lath, wire fabric lath and medal accessories shall conform with approved standards.
[2] For nailable nonload bearing metal supports, use annular threaded nails or approved staples.
[3] For fire resistive construction, see Table No. 43-B and 43-C. For shear-resisting elements, see Table No. 47-1. Approved wire and sheet metal attachment clips may be used.
[4] With chisel or divergent points.
[5] Maximum spacing of attachments from longitudinal edges shall not exceed 2 inches.
[6] Screws shall be an approved type long enough to penetrate into wood framing not less than ⅝ inch and through metal supports adaptable for screw attachment not less than ¼ inch.
[7] When lath and stripping are stapled simultaneously, increase leg length of staple ⅛ inch.
[8] For interiors only.
[9] Attach self-furring wire fabric lath to supports at furring device.
[10] Three attachments per 16-inch-wide lath per bearing. Four attachments per 24-inch-wide lath per bearing.
[11] Supports spaced 24 inches on center. Four attachments per 16-inch-wide lath per bearing. Five attachments per 24-inch-wide lath per bearing.

3. Structural plate lines or concentrations of large dimension timber members in wood construction.
4. Midpoints of maximum spacing of supports.
5. Where main columns or structural beams join with walls and ceilings.
6. Over construction, expansion, or control joints.
7. Over junctures of dissimilar bases.

Most plaster work is done from multistage scaffolding. Plaster operations usually start and stop at the staging levels. Unsightly laps and joints might be avoided if horizontal relief joints were designed to be located at the scaffold levels. Changes in plane or construction materials also serve as good stopping points for plaster finishes without laps.

Deep-set window sills, parapet tops, and tops of handrails, or any wall surface installed in a plane of less than 60 deg from the horizontal, must be given special consideration. Surfaces such as these are no longer considered walls, and they should be protected from moisture intrusion, much like a roof. The lath and plaster on these surfaces can only be considered cosmetic; they provide little, if any, moisture protection.

Control joints in plaster over masonry or concrete may be spaced farther apart than joints in plaster over open framing. They must be located over any construction joints in the substrate, and they should be installed at the juncture of concrete or masonry with frame construction.

CHAPTER 8-INSTALLATION OF METAL LATH

8.1-General

Metal plaster bases, such as expanded metal, woven wire, and welded wire, may be applied over a variety of substrates. Metal lath may be applied directly to wood stud or metal stud framing, but this type of open framing is often covered with solid sheathing such as exterior gypsum, plywood, or particle board. The strength of the fastener attachment to most sheathing is not adequate to support the lath and plaster membrane. Longer fasteners for lath are required to penetrate through the sheathing into the framing.

Staples, nails, or screws are the most commonly used fasteners for attaching lath to wood or steel framing. Wire ties are sometimes used, and they are recommended for certain installations, such as ceiling construction.

Manufacturers of approved power-driven or powder-driven fasteners have reference tables that will provide pullout and shear values for different size fasteners in various substrate.

8.2-Application of metal plaster bases

Metal lath and wire fabric lath should be applied with the long dimension of the sheets perpendicular to the supports.

Lap expanded metal lath ½ in. at sides (horizontal) and 1 in. on ends (vertical). Rib metal lath with edge ribs greater than ⅛ in. should be lapped at the sides by nesting outside ribs. When edge ribs are ⅛ in. or less, rib metal lath should be lapped ½ in. at the sides and 1 in. on the ends.

Wire fabric lath should be lapped at least one mesh at sides and ends, but never less than 1 in.

The ends of adjoining horizontal sheets or rolls of lath should be staggered. Where end laps of lath do not occur over supports they should be securely tied together or laced with not less than 18 U.S. gage galvanized or annealed steel wire.

When a metal plaster base with factory-applied paper backing is used, the vertical and horizontal laps shall be backing on backing, and metal on metal. Lap backing on horizontal and vertical surfaces are a minimum of 1 in. Laps should be made so that any moisture will flow to the exterior.

Backing should be continuous behind control joints. Metal lath should be interrupted with a ½-in. gap behind control joints to enable the joint to function properly.

Where furred or suspended ceilings butt into or are penetrated by columns, walls, beams, or other elements, terminate the sides and ends of the ceiling lath at the horizontal internal angles with corner beads, control joints, or similar approved devices. This will keep the sides and ends of the ceiling lath and plaster free from the adjoining vertical elements.

Where load-bearing walls or partitions butt into structural walls, columns, or floor and roof slabs: a) terminate the sides or ends of the wall or partitions; b) lath at the internal angles with a casing bead, control joint, or similar device. Install metal lath true to line, level, plumb, and square, or else curved as necessary to provide a proper finish plane for the plaster finish.

8.3-Attachment of metal plaster bases to supports

Metal lath and wire fabric lath used as a reinforcement for portland cement plaster shall be furred out from vertical supports a nominal ¼ in. Self-furring lath meets this requirement. Furring of expanded metal lath is not required on supports having a bearing surface width of 1 and ⅝ in. or less.

Expanded metal lath and wire fabric lath should be attached to supports with fasteners installed not more than 6 in. apart.

8.4-Attachment of metal lath to solid bases

When poor bond or no bond to a surface is anticipated, the use of metal reinforcement anchored to the surface is recommended. The use of a paper backing or other debonder between the solid base and scratch coat is recommended, to prevent stresses which could cause cracking.

When expanded metal or wire fabric lath is to be attached to monolithic concrete or masonry, the lath must be the self-furring type. On vertical surfaces lath should weigh not less than 2.5 lb/yd^2. On horizontal surfaces, lath should weigh not less than 3.4 lb/yd^2. Attachments to the substrate should be made at furring points.

Fasteners should have large heads, capable of securing at least two strands of reinforcement, or else be used with metal, neoprene, or vinyl washers. Forced entry types are recommended. The type and size of fastener are determined by the substrate, type and weight of lath, and any additional material supported by the fasteners.

Metal plaster bases should be attached with at least five fasteners at a distance not less than 16 in. on center horizontally and not more than 16 in. on center vertically.

Tie side laps or lace between the cross rows. All end laps should be fastened and side laps laced.

A self-furring lath should be used when a greater thickness of plaster is desired. Power-driven or powder-driven fasteners are preferred over hand-driven concrete stub nails or cut nails for attaching self-furring lath.

CHAPTER 9-SURFACE PREPARATION OF SOLID BASES

9.1-General

All solid bases, such as concrete, concrete masonry, or clay masonry to which plaster will be applied directly should be straight, true to line and plane. They should be cleaned or roughened to insure both a good chemical and mechanical bond.

Cleaning agents can be used to remove most surface contaminants. Careful attention to manufacturer's directions is necessary. Particular care is required to insure complete wash down and neutralization of the substrate.

Wire brushes, hammer and chisel, and other hand or power tools can be used to remove mortar and concrete from the surface.

Water blasting and dry blasting are also effective methods of removing contaminates. Care must be taken to avoid cutting too deeply.

9.2-Concrete

ASTM standards D 4258, D 4259, D 4262, and D 4263 are guides for surface preparation of concrete, and techniques described in these standards are applicable to the preparation of solid bases for plastering.

9.2.1 *New concrete*-New concrete should be cured for a minimum of 28 days. Laitance, form release agents, and curing compounds can be removed by light sandblasting.

9.2.2 *Old Concrete*-Concrete that has been in service will generally require more surface preparation to be made suitable for direct application of plaster.

Spalled areas or delaminated concrete should be removed and these surfaces prepared. Patch voids, form tie holes or other surface defects prior to applying plaster or leveling lifts.

Alignment of line and plane should be inspected, and deviations corrected by means of leveling courses following surface preparation.

9.3-Concrete masonry

Use open-textured concrete masonry units for concrete masonry walls that are to be plastered. The open texture promotes good mechanical bond.

Concrete masonry walls should be aligned properly. Deviations from the true plane of the wall will lead to variable plaster thickness. If misalignment is excessive, furring and lathing may be necessary.

Joints should be cut flush, not tooled or floated. Mortar should be removed from the surface of masonry units, and the wall should be fully cured and be carrying its design dead load before plaster is applied.

Refer to ASTM D 4261 for the recommended practice for surface cleaning concrete unit masonry for coating.

9.4-Clay masonry

Joints in clay masonry walls should be inspected. Remove crumbling or friable mortar, replace with new mortar, striking the joints flush. Brick or clay masonry that is disintegrating may require metal lath as a mechanical support for the plaster.

Hard or medium clay tile, or unglazed clay brick are usually roughened or abraded to remove film-forming or penetrating water repellents. This helps promote good chemical and mechanical bond of the plaster.

9.5-Surface applied bonding agents

Surface-applied bonding agents should be used on all smooth or very dense substrates such as clay masonry or unglazed fired brick, or on substrates with friable surfaces. Surface-applied bonding agents can be used when hot, dry, windy conditions make dampening or misting of the substrate impractical. They can also be used on porous surfaces to reduce wicking of moisture from wet plaster. Surface-applied bonding agents can be applied by brush, roller, or spray. They are generally water-based, single-component formulations, which are applied undiluted.

Some surface-applied bonding agents can be applied and remain exposed for several days prior to plaster application. Others require plaster application within 24 hr. Refer to the manufacturer's directions for use.

9.6-Integrally mixed bonding agents

Integrally mixed bonding agents are generally water-based acrylic or styrene-butadiene latex formulations which are added to the plaster mix during the mixing process. Integrally mixed bonding agents are usually diluted, one part bonding agent to three parts potable water.

Integrally mixed bonding agents improve the plaster bond as well as flexural and tensile strengths. Unless otherwise specified, integrally mixed bonding agents can be used in conjunction with some surface applied bonding agents. Refer to manufacturer's directions for use.

CHAPTER 10-PORTLAND CEMENT PLASTER-PROPORTIONS AND MIXING

10.1-General

Proportioning and mixing portland cement plaster are two important factors that affect the final quality and serviceability of the hardened plaster. Proportions of the ingredients in the plaster mix should be in accordance with project specifications, local building codes, and ASTM C 926.

10.2-Plaster base and permissible mixes

The suitability of a specific mix is influenced greatly by the compatibility of the plaster base with the plaster mix. Table 10.1 is the recommended combination of plaster bases and mixes from ASTM C 926.

10.3-Proportioning

Industry standards and local codes have developed proportioning tables for plaster mixes. Tables from ASTM C 926 (see Table 10.2) and the UBC Chapter 47 (see Table 10.3) are illustrated below.

10.4-Batching and mixing

Measurement of cementitious material should be based on full bag increments of cement whenever possible. Several methods of measurement of sand into the mixer are acceptable, including:

a. Filling to a predetermined level in the bowl of the mixer, as determined by measurement with a cubic foot box;

b. Use of a cubic foot box to measure sand; or use of a 5 gal. pail (0.8 ft^3);

c. By shovel count, if standardized each day with a cubic foot box.

Portland cement plaster should be mixed in a paddle drum mixer for 3 to 10 min. Excessive mixing which

Table 10.l-Plaster bases-Permissible mixes (ASTM C 926, Table 1) (Note-See Table 10.2 for plaster mix symbols)

	Mixes for plaster coats	
	First (scratch)	Second (brown)
Low absorption, such as dense, smooth clay tile or brick	C	C or L or M or CM[A]
	CM	CM or M
	CP	CP or P
	P	P
High absorption, such as concrete masonry, porous clay brick, or tile	L	L
	M	M
	P	P
Metal plaster base[B]	C	C or L or M or CM
	L	L
	CM	CM or M
	M	M
	CP	CP or P

[A] The letter designations C, CM, L, M, CP, and P as defined in ASTM C 926 Table 2 are convenience symbols for ASTM C 926 Tables 1 and 2. They should not be used in contract specifications.
[B] Metal plaster base with paper&king, under extremely severe drying conditons, may require dampening of the paper prior to the application of plaster.

could be detrimental to the quality of the plaster should be avoided.

The amount of water added will vary with the sand moisture content and other factors. Only sufficient water should be added to produce a suitably plastic mortar. Excessive mix water lowers strength, increases shrinkage, increases the possibility of crazing or cracking, and reduces resistance to freeze-thaw damage.

The suggested sequence of adding ingredients is to introduce two-thirds the required water into the mixer hopper with half the sand. Next, add the amount of cement for the entire batch. The balance of the sand is added, followed by enough water to achieve the desired workability and consistency.

Color pigments should be added to the initial mixing water and mixed for a short time to help dispersion.

mLatex integral bonding agents should be mixed together with water and then added to the mixture. Mix the plaster no more than 10 min to avoid entrainment of excessive air.

CHAPTER 11-APPLICATION OF PORTLAND CEMENT PLASTER

11.1-Inspection and approval of base

Examine the base before application of plaster for compliance to project specifications, codes, and standards. Check for the proper installation of lathing and for surface conditions which may impair the quality of the plaster.

11.1.1 *Metal reinforced base*-lathing over metal or wood studs should be checked to verify proper installation of the lath and backup paper. Water-resistant paper should be installed shingle style, with the first layer applied at the bottom of the surface to be plastered. Paper and lath should be taut and attached at proper spacing over the studs. See Chapter 5 for detailed instructions.

11.1.2 *Solid base*-Solid bases, including concrete, concrete masonry, and clay masonry, should be inspected and prepared according to the procedures described in Chapter 9.

The base should be checked for good absorption. It is important that the rate of absorption be as uniform as possible over the entire surface. Highly absorptive surfaces should be moistened prior to the application of the scratch coat to reduce absorption of plaster mix water into the base.

11.2-Application of plaster

11.2.1 *Hand application*-For hand application, the plasterer applies the plaster to the surface using a hawk and trowel. Only the plasterer can determine the amount of water needed to bring the plaster to the proper consistency.

11.2.2 *Machine application*-Plaster pumps are used to spray the plaster onto wall and ceiling surfaces. Batches of cementitious material, sand, and water are mixed in the hopper and continuously pumped onto the surface. The person operating the mixer controls the amount of mixing water. The person operating the hose (the nozzleman) controls the spray pattern of the wet plaster by ad-

Table 10.2-Base-coat proportions,* parts by volume[B] (ASTM C 926, Table 2)

Plaster mix symbols	Cementitious materials				Volume of aggregate per sum of cementitious materials		
	Portland cement	Lime	Masonry cement	Plastic cement	1st coat	2nd[C] coat	1st and 2nd coats
C	1	0-¾			2½-4	3-5	3-4
CM	1		1-2		2½-4	3-5	1½-2
L	1	¾-1½			2½-4	3-5	2-3
M			1		2½-4	3-5	
CP	1			1	2½-4	3-5	2-3
P				1	2½-4	3-5	3-4

[A] The mix proportions for plaster scratch and brown coats to receive ceramic tile shall be in accordance with the applicable requirements of ANSI A108.1 series applicable to specified method of setting time.
[B] Variations in lime, sand, and perlite contents are allowed due to variation in local sands and insulation and weight requirements. A higher lime content will generally support a higher aggregate content without loss of workability. The workability of the plaster mix will govern the amounts of lime, sand, or perlite.
[C] The same or a greater sand proportion shall be used in the second coat, than is used in the first coat, within the limits shown.

Table 10.3-Portland cement plasters[1] (UBC, Table 47-F)*

Portland cement plaster

Coat	Volume cement	Maximum weight (or volume) lime per volume cement[2]	Maximum volume sand per volume cement[3]	Approximate minimum thickness[4]	Minimum period moist curing	Minimum interval between coats
First	1	20 lbs	4	⅜ in.[5]	48[6] hours	48[7] hours
Second	1	20 lbs	5	1st and 2nd coats total ¾ in.	48 hours	7 days[8]
Finish	1	1[9]	3	lst, 2nd and finish coats ⅞ in.	—	8

Portland cement-lime plaster”

Coat	Volume cement[11]	Maximum volume lime Per volume cement	Maximum volume sand Per combined volumes cement and lime	Approximate minimum thickness[4]	Minimum Period moist curing	Minimum interval between coats
First	1	1	4	⅜ in.[5]	48[6] hours	48[7] hours
Second	1	1	4½	1st and 2nd coats total ¾ in.	48 hours	7 days[8]
Finish	**1**	**1[9]**	**3**	lst, 2nd and finish coats ⅞ in.	—	8

[1] Exposed aggregate plaster shall be applied in accordance with Section 4709. Minimum overall thickness shall be 3/4 in.
[2] Up to 20 pounds of dry hydrated lime (or an equivalent amount of lime putty) may be used as a plasticizing agent in proportion to each sack (cubic foot) of Type I and Type II standard portland cement in first and second coats of plaster. See section 4708 (a) for use of plastic cement.
3 When determining the amount of sand in set plaster, a tolerance of 10 percent may be allowed.
4 See Table No. 47-D.
5 Measured from face of support or backing to crest of scored plaster.
6 See Section 4707 (c) 2.
7 Twenty-four-hour minimum interval between coats of interior portland cement plaster. For alternate method of application, see Section 4708 (c).
8 Finish coat plaster may be applied to interior portland cement base coats after a 48-hour period.
9 For finish coat plaster, up to an equal part of dry hydrated lime by weight (or an equivalent volume of lime putty) may be added to Types I, II, and III standard portland cement.
10 No additions of plasticizing agents shah be made.
11 Type I, II, or III standard Portland cement. See Section 4708 (a) for use of plastic cement.
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justing the air jet, air pressure, and nozzle orifice size. Uniform dispersion is attained when the nozzle is held about 12 in. away from and perpendicular to the working surface.

11.3-Application of coats

Plaster is applied usually in two or three coats. The first coat is called the scratch coat, followed by the brown coat. Most applications call for a finish coat. Color and texture are generally properties of the finish coat.

The thickness of the individual coats should be stated in the project specifications, and should conform to to the requirements of ASTM C 926 (see Table 11.1) or UBC Table 47F (see Table 10.2).

11.3.1 *Scratch coat plastering*-The scratch coat should be thick enough to provide a good bond between the plaster and the base. On metal plaster bases, the scratch coat should fully embed the lath. Avoid excessive troweling during hand application. After application, the scratch coat surface should be rodded plane, and vertical surfaces should be scored horizontally. The purpose of scoring is to provide a mechanical key between the scratch and brown coats. Scoring should be shallow, approximately ⅛ in. Deep scoring may cause voids between the scratch and brown coats.

11.3.2 *Delay between coats*-The traditional method of plastering requires a delay between the scratch and brown coats. The intent of this delay is to allow each coat of plaster to cure independently. The disadvantage of this method is that moist curing is required during the delay period. Additional costs may be incurred for labor and materials, and the delay will prolong the job.

Another accepted method of plastering is the “double back” application of successive coats with little or no delay between coats. By promoting better bond and more uniform curing throughout the base coat, this method eliminates the delay between coats as well as the moist curing requirement of the scratch coat.

When using the double back method, the full thicknesses of the scratch and brown coats are applied as rapidly as the two coats can be put in place. The brown coat should be applied only when the scratch coat is rigid enough to receive the brown coat without cracking from the pressure of the brown coat application. This pro-

Table 11.1-Nominal[A] plaster thickness for three- and two-coat work[B] (ASTM C 926, Table 4)

Base	Vertical 1st coat	Vertical 2nd coat	Vertical 3rd coat	Vertical Total	Horizontal 1st coat	Horizontal 2nd coat	Horizontal 3rd coat	Total
			Interior					
Three-coat work:[E]								
Metal plaster base	⅜ (9.5)	⅜ (9.5)	⅛ (3)	⅞ (22)	¼ (6)	¼ (6)	⅛ (3)	⅝ (16)
Solid plaster base:[F]								
Unit masonry								
Cast-in-place or precast concrete	⅝ (16)	¼ (6)	⅛ (3)	⅝ (16)	Use two-coat work.			
Metal plaster base over solid base	¼ (6)	¼ (6)	⅛ (3)	⅝ (16)	½ (12.5)	¼ (6)	⅛ (3)	⅜ (9.5) max.[G,H]
Two-coat work:[I]	½ (12.5)	¼ (6)	⅛ (3)	⅞ (22)				⅞ (22)
Solid plaster base:[F]								
Unit masonry	⅜ (9.5)	⅛ (3)		½ (12.5)				⅜ (9.5)[G,H]
Cast-in-place or precast concrete	¼ (6)	⅛ (3)[G,H]		⅜ (9.5)				⅜ (9.5)
			Exterior					
Three-coat work:[E]								
Metal plaster base	⅜ (9.5)	⅜ (9.5)	⅛ (3)	⅞ (22)	¼ (6)	¼ (6)	⅛ (3)	⅝ (16)
Solid plaster base:[F]								
Unit masonry	¼ (6)	¼ (6)	⅛ (3)	⅝ (16)				
Cast-in-place or precast concrete	¼ (6)	¼ (6)	⅛ (3)	⅝ (16)				
Metal plaster over solid base	½ (12.5)	¼ (6)	⅛ (3)[G,H]	⅞ (22)	Use two-coat work.			⅜ (9.5) max
Two-coat work:[I]					½ (12.5)	¼ (6)	¼ (6)	⅞ (22)
Solid plaster base:[F]								
Unit masonry	⅜ (9.5)	⅛ (3)		½ (12.5)				⅜ (9.5) max
Cast-in-place precast	¼ (6)	⅛ (3)		⅜ (9.5)				⅜ (9.5) max

[A] Approximateminimum thickness: 1st coat-⅝ in. (9.5 mm): 1st and 2nd coats-total ¾ in. (9.0 mm) lst, 2nd. and finish ⅞ in. (22.2 mm).
[B] Where a fire rating is required, plaster thickness should conform to the applicable building code or to an approved test assembly.
[C] For solid plaster partitions, additional coats should be applied to meet the finished thickness specified.
[D] For exposed aggregate finishes, the second (brown) coat may become the "bedding" coat and should be of sufficient thickness to receive and hold the aggregate, but the total thickness shown in Table 4 should be achieved.
[E] Where three-coat work is required, a dash-bond or brush coat of plaster materials should not be accepted as a required coat.
[F] Where masonry and concrete surfaces vary in plane, plaster thickness required to produce level surfaces cannot be uniform.
[G] On horizontal solid base surfaces, such as ceilings or sofffits, requiring more than ⅜ in. (9.5 mm) plaster thickness to obtain a level plane, metal plaster base should be attached to the concrete, and the thickness specified for three-coat metal plaster base over solid base should apply.
[H] Where horizontal solid base surfaces, such as ceilings or soffits, require ⅜ in. (95 mm) or less plaster thickness to level and decorate, and have no other requirements, a liquid bonding agent or dash-bond coat may be used.
[I] Table 4 shows only the first and finish coats for vertical surfaces and only the total thickness on horizontal surfaces for two-coat work.
[J] Exclusive of texture.

cedure should be restricted to plaster on a solid base or lath that is applied over sheathed frame construction.

Job conditions or project specifications may require different time periods between the scratch and brown coats, but prolonged delays should be avoided.

11.3.3 *Brown coat plastering*-The brown coat is adjusted usually to carry more sand than the scratch coat, and it should be mixed according to Table 10.2. Required thickness may vary according to local codes.

Moisten the scratch coat with water before applying the brown coat to reduce the initial absorption of water. Allow the water sheen on the surface of the scratch coat to disappear before applying the brown coat. If the prewetting operation interferes with the proper floating of the plaster surface, it may be reduced or eliminated depending upon the moisture condition of the scratch coat.

Spray or hand-trowel the brown coat with enough force to key this coat to the scored scratch coat. After obtaining the desired thickness, rod to a plane surface. Allow sufficient stiffening to occur prior to floating.

The floating of the brown coat is required to reconsolidate the plaster coat. This densification process reduces the potential of cracking caused by shrinkage.

The brown coat, regardless of application method, should be moist-cured for a minimum of 2 days. Check local codes and project specifications for variations of this curing schedule.

11.3.4 *Finish coat application*-The finish coat plaster mixture, texture, color, and application method should be known before scratch and brown coats are applied. Properties of the first two coats can affect the finish coat appearance. Sample panels, if required, should be completed before any jobsite plastering starts.

Immediately before applying the finish coat, moisten the base coat to control absorption during application and tooling of the finish.

Care should be taken to apply the finish coat continuously between natural breaks in the surface plane. On multiple-level staged walls, lower levels of plaster in the same panel should be continued immediately to avoid joining stains, shouldering, and texture variation. In machine-dashed textures, the gun nozzle should be maintained perpendicular to the wall plane in all areas, including scaffold landings and behind scaffold poles and braces. The finish coat should not be applied immediately following rain or when rain is imminent.

CHAPTER 12-PLASTER FINISHES

12.1—General

The finished surface of portland cement plaster is an esthetic expression of color, texture, form, contours, ornamentation, and decoration. Plaster affords an infinite variety of surface treatments, limited only by the imagination and skill of the plasterer, and subject only to the inherent characteristics of the materials.

Standards have evolved for a variety of finishes. However, even with the more commonly accepted textures, differences in local practices and nomenclature make it difficult to reference standard finishes. Textures or colors should never be selected on the basis of a verbal description.

To insure that the intended color and texture selected is correct, sample panels should be made on the job by the plasterers who will be doing the actual work, i.e., using the job materials. The sample should be large enough to incorporate every component in the wall assembly including joints, metal trim, and other aspects of the desired plaster appearance. The sample should remain on the jobsite until the project is completed and accepted. These procedures are important particularly when a colored finish is specified.

12.2-Color

The final color of finish coats is achieved by the addition of colored pigments, colored aggregates, or both, in the plaster mix. Finely ground pigments of metallic oxides are added at the jobsite during mixing of the portland cement plaster finish. Most proprietary, prepackaged finish mixes contain pigments that are preblended in the manufacturing process.

12.2.1 *Jobsite mixing*-When mixing colored finish coat plaster on the jobsite, extra care must be taken to insure color uniformity. The materials should be proportioned in a uniform and consistent manner. Packets of measured and prepackaged pigment for specific color tones provide the best jobsite control. Uniform moisture content of the sand is critical and should be maintained. This may be achieved by covering the sand with a protective covering during rainy or hot, low-humidity periods. Water added to the mix should be measured and consistent from batch to batch. Each material should be from a single source.

12.2.2 *Premixed*-Factory produced, prepackaged finish mixes produce the most consistent colored finishes. They may be formulated specifically for certain surface treatments such as simulated brick, artificial stone, unusually thick finish coats, tunnel dash finishes, etc. Deep color tones of integrally colored portland cement plaster are difficult to achieve.

12.2.3 *Curing*-Damp curing of colored portland cement plaster finishes is seldom specified because uneven wetting and drying may cause color variations. The consistency of color is improved by proper moist curing of the base coat plaster for 48 hr, followed by a minimum delay of 5 days prior to the application of the colored finish coat.

12.3-Textures

Any texture may be applied to either interior or exterior portland cement plaster base coats. Generally, the "heavier" ones, those with deeper relief, are only practical primarily for exteriors. Deeper textures may require that additional or coarser sand be added to minimize check or craze cracking.

Finish textured patterns may be categorized. Each may be modified by the applicator's personal technique, or in accordance with a general design concept.

12.3.1 *Sand float texture*-The coarseness and depth of the raised aggregate are governed by the sieve sixes of the aggregate. Trowel on the finish coat and allow it to firm up (take up) sufficiently before working with a float. Using a circular motion, rub the surface with a moistened sponge float, bringing sand granules to the surface, to achieve a uniform texture. See Fig. 12.1.

12.3.2 *Dash textures*-Dash textures may be applied by hand or by machine. Depth of the texture may be controlled in machine-applied finish by varying the aggregate sixes, the consistency of the mortar, the air pressure at the nozzle, the volume of the plaster flow, or by varying the size of the orifice of the pump nozzle. See Fig. 12.2.

12.3.3 *Scraped textures*-A torn surface effect is achieved by drawing the edge of a sharp straight tool held at right angles to the plaster plane after the plaster has achieved a slight stiffening. See Fig. 12.3.

12.3.4 *Skip trowel or modified spanish texture*-The texture may range from a fine lace with small feathery texture pats to one where texture pats may be several inches in diameter. This application usually consists of first applying a full-cover background color coat and then doubling back to apply the desired texture pattern. The finish may be of variant thicknesses or dispersal patterns. Some textures may be lightly "knocked down" (troweled). See Fig. 12.4.

12.3.5 *Marblecrete*-Marblecrete refers to an exposed aggregate finish consisting of a bedding coat into which chips, stones, or other hard aggregates are embedded. Embedment may be achieved by the aggregate being thrown into the bedding coat by hand, or blown into the surface with a rock dash gun. The aggregate is then tamped to a uniform embedment while the bedding coat is still soft. See Fig. 12.5.

12.3.6 *Brocade or knock-down dash*-Apply a first dash coat for full color coverage. Apply a second dash coat for

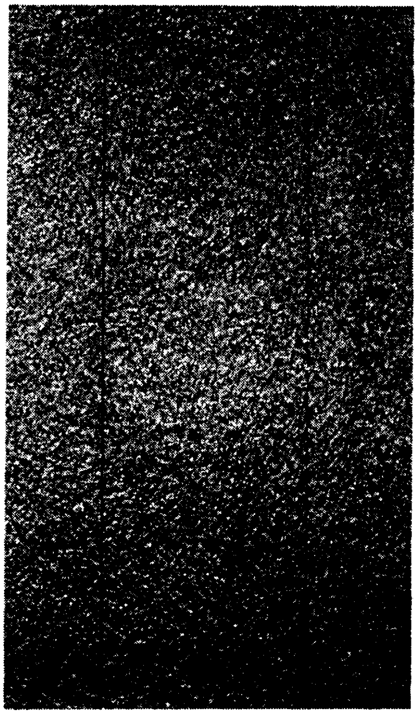

Fig. 12.1-Float (Photo courtesy of Walls and Ceilings Magazine, Tampa, FL)

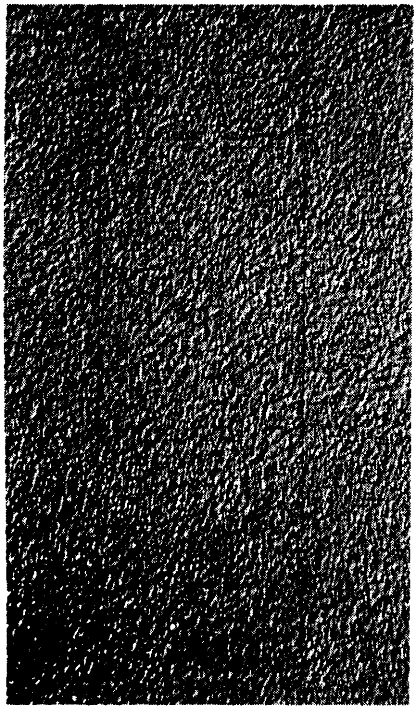

Fig. 12.2-Light Dash (Photo courtesy of Walls and Ceilings Magazine, Tampa, FL)

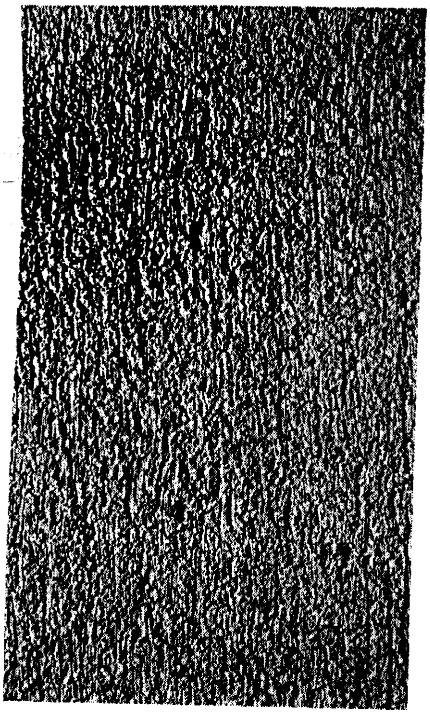

Fig. 12.3-Scraped (Photo courtesy of Walls and Ceilings Magazine, Tampa, FL)

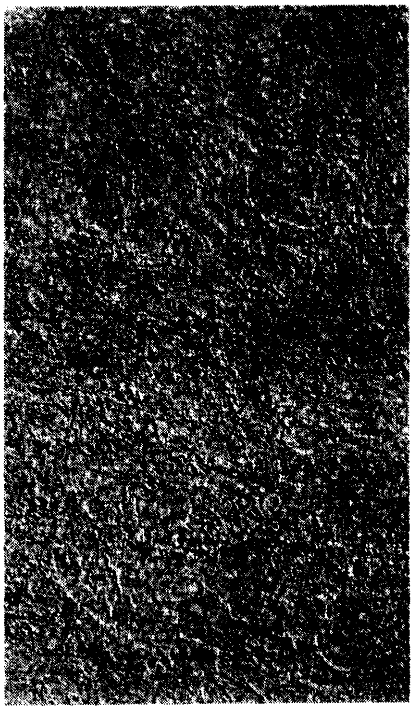

Fig. 12.4-Spanish (Photo courtesy of Walls and Ceilings Magazine, Tampa, FL)

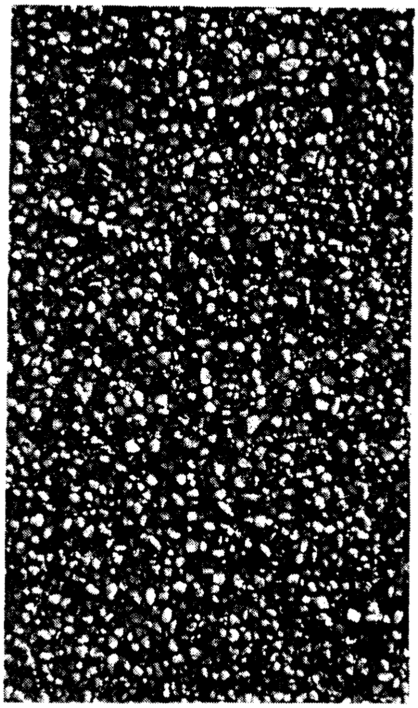

Fig. 12. 5-Marblecrete (Photo courtesy of Walls and Ceilings Magazine, Tampa, FL)

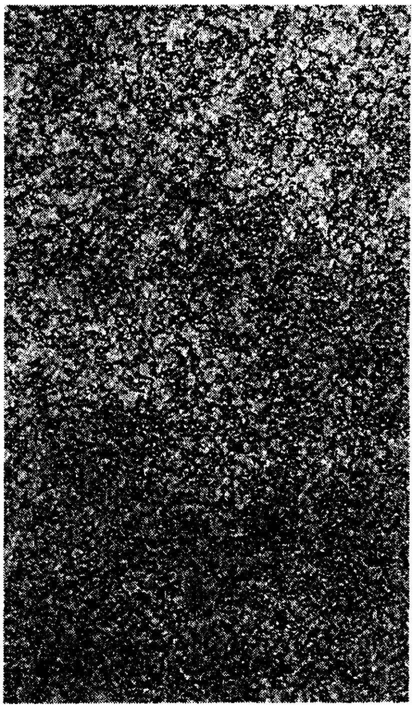

Fig. 12.6-Brocade (Photo courtesy of Walls and Ceilings Magazine, Tampa, FL)

texture depth and uniformity. After initial take-up, lightly trowel the high points to a uniform pattern. See Fig. 12.6.

12.3.7 *Trowel sweep*-Using mortar with coarse aggregate, trowel on in fan-shaped or vertical strokes. Lap each stroke to form high ridges off the toe of the trowel. Many variations of this type of texture are possible. See Fig. 12.7.

Fig. 12. 7-Trowel sweep (Photo courtesy of Walls and Ceilings Magazine, Tampa, FL)

Fig. 12.8-California (Photo courtesy of Walls and Ceilings Magazine, Tampa, FL)

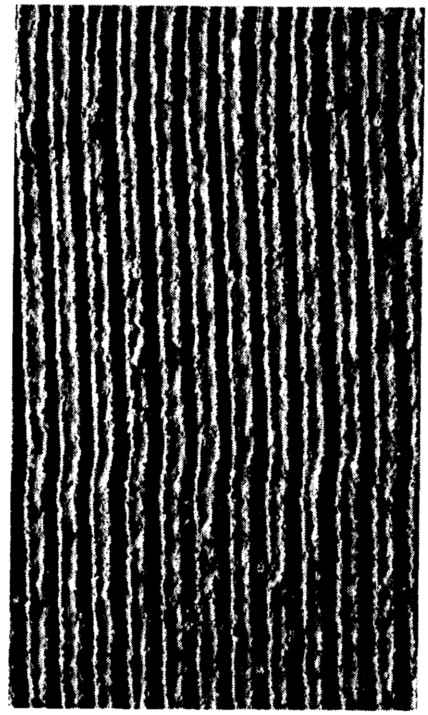

Fig. I2.9-Combed (Photo courtesy of Walls and Ceilings Magazine, Tampa, FL)

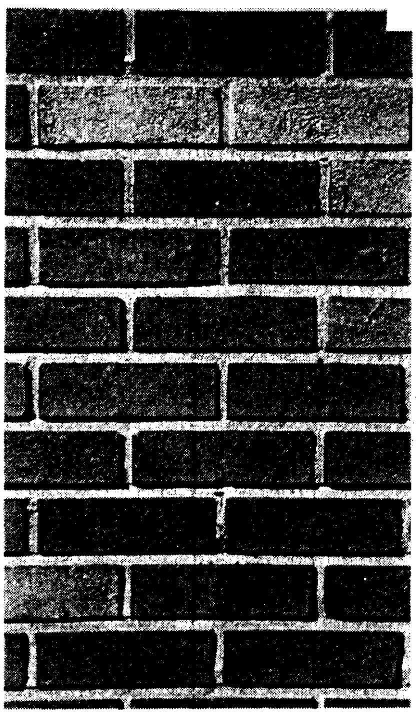

Fig. 12.10-Simulated brick (Photo courtesy of Walls and Ceilings Magazine, Tampa, FL)

Fig. 12.11-English (Photo courtesy of Walls and Ceilings Magazine, Tampa, FL)

12.3.8 *Sacked or brushed (California mission)-* Trowel on a first coat and completely cover the base. Apply a thin texture coat with trowel in a random pattern, overlapping the strokes. Rub with burlap or damp brush. Flatten the higher areas with a trowel. See Fig. 12.8.

12.3.9 *Combed, marked off, or carved-*Apply finish coat in sufficient thickness to accommodate depth of grooves or carved lines without exposing base coat. Rod and darby, leaving the surface reasonably straight and true. Using a strip as a guide, comb surface vertically (or horizontally) with a template formed to shape the pattern detail. See Fig. 12.9.

12.3.10 *Simulated stone, brick or wood*-Trowel on a first coat of simulated mortar-joint material, then trowel on a second coat of colored finish material matching the desired brick, stone, or wood. Rod and darby to the desired plane. Comb or broom the surface with a coarse fiber brush, or broom to achieve the desired texture. A template simulating brick, stone, or wood, or a straightedge can be used. Rake or cut joints to depth required to expose the first coat material. See Fig. 12.10.

12.3.11 *English texture*-Trowel on a first coat, completely covering the base. Then, using a rounded trowel, apply a thick texture coat with short strokes in varying directions, leaving a rough, irregular pattern. See Fig. 12.11.

12.3.12 *Smooth finish*-Smooth troweled surfaces are discouraged because of their tendency to crack, particularly over open wood framed supports. Burnishing the finish over open-framed construction is almost certain to induce cracking, and create discoloration of an integrally colored finish.

Apply finish material ⅛ to ¼ in. thick in a double-back method with a top coat applied in a random stroke pattern, and with all strokes not vertical. Work to architectural breaks and follow up lower levels of application immediately.

Before initial take-up, trowel finish plaster lightly in a random pattern horizontally, diagonally, and vertically. Do not compact the finish by hard troweling.

Some minor imperfections are unavoidable in the finish plaster.

CHAPTER 13-CURING

Portland cement plaster, like other portland cement-based products, requires moisture to hydrate properly the portland cement. Because of the large exposed surfaces of plaster work, moist curing is required to replace the moisture that is absorbed into the base or lost through evaporation.

The extent of the curing required is determined by the rate and amount of moisture lost from the plaster coat, which in turn is influenced by the surface characteristics of the plaster and the weather. Temperature, wind, and relative humidity should be considered to insure the best results.

Generally, fogging the surface with water, i.e., keeping it moist for the first few days after application, should suffice. The plaster should be kept moist and not be allowed to dry out during this curing period.

If the relative humidity is above 70 percent, the frequency of fogging may be reduced. If it is hot, dry, and windy, the surface may require fogging at a greater frequency.

Under extreme weather conditions, it may be necessary to cover the plaster with a sheet of polyethylene plastic to retard evaporation. An uncolored or light-toned colored finish coat may require additional moist curing in the form of fogging, to prevent the portland cement plaster from craze cracking or chalking.

These conditions will vary from region to region, and season to season. Check the appropriate building codes and project specifications, as well as local industry recommendations for variations of this curing schedule.

Membrane curing compounds are not used generally to cure portland cement plaster, particularly when the surface is to be painted. However, during extreme weather conditions, if painting is to be delayed at least 2 weeks, a resin base-curing membrane may be used as long as it is compatible with the paint that will be used.

If the portland cement plaster will be subjected to freezing temperatures, it should not be moist-cured during the time when freezing temperatures are expected because of the risk of freezing and thawing damage.

Plaster installed when ambient temperatures are below 40 deg must be maintained in a sheltered and heated environment with continued curing to assure cement hydration.

CHAPTER 14-TESTING

14.1—General

Standard specifications and test methods for the materials used in portland cement-based plaster, are contained in ASTM C 926. Proportions of materials are also specified in ASTM C 926 and in most building codes. However, because the structural value of plaster is not included in the building design, there are no physical requirements or standard test methods specifically designed to test the performance characteristics of in-place plaster.

The purpose of this chapter is to provide guidance in the evaluation of materials to be used in plaster, in the analysis of hardened plaster, and what to look for in the field.

14.2-Materials

Lacking a standard specifically designed for plaster, ASTM C 780 may be used for guidance. When proprietary materials are to be added to portland cement plasters, these same test methods may be used as a means of evaluation.

14.3-Test method for hardened plaster evaluation

14.3.1 *General*-Test results from chemical or petrographic analyses yield only the approximate composition of plaster based on calculations using assumed values, unless samples of the actual sand and cement used to produce the plaster are also tested.

14.3.2 *Chemical analysis*-An oxide analysis may provide information regarding the composition of the plaster. Cement content may be determined by ASTM C 1084.

14.3.3 *Petrographic examination*-Additional information on the composition of the plaster may be obtained from examination done in accordance with ASTM C 856.

14.4-Field evaluation checklist

Items to be inspected when making a visual analysis of an in-place wall assembly should include the following:

a) Proper attachment and lapping of building paper and lath
b) Coverage of the plaster and embedment of reinforcement
c) Regularity of scoring, floating, texture patterns, etc.
d) Uniformity and joining
e) Integrity of planes, angles, corners, lines, etc.
f) Thickness of coats, both individual and combined
g) Proper bond between base and successive coats
h) Plaster hardness, color uniformity, and surface texture

CHAPTER 15-PATCHING AND REPAIR OF PLASTERED SURFACES

15.1-General

Patching generally requires a higher level of craftsmanship than new plaster work.

Patching may be defined as:

1. Remedial or corrective work to repair defects in newly applied plaster.
2. Working new plaster full-depth to old plaster as in additions, remodeling, or repairing major damage.
3. Maintenance, upgrading, redecoration of existing plaster, or correction of deterioration due to the elements, chemical attack, and abuse or misuse of plaster surfaces.

Generally accepted procedures for patching work include the following:

1. Determine the component materials involved to the extent possible, and use the same or similar materials. Water-soluble materials should not be used in wet exposures.
2. Determine the extent and nature of damage or deficiency.
3. Remove loose, unbonded, or damaged material.
4. When smaller areas are to be replaced, the edges of all the coats are roughly in the same location. For larger areas, each succeeding coat is cut back further, the base coat being the smallest area and the finish coat being the largest area to be patched.
5. Apply a new layer of properly lapped paper and lath to the bottom surfaces of an area that is to receive new plaster. Apply a suitable bonding agent to the exposed edges of old plaster. On solid bases, remove loose material prior to applying a bonding agent. Avoid applying a bonding agent to the finish surface of the adjacent existing surface.
6. Apply new material in not less than two coats, with time to set between coats.

Blocking coat(s)-These are forced into new areas, and scraped or rodded flush to existing work in one or more coats as required. When using smaller plugs or patches, accelerate blocking coat plaster.

Where existing surfaces are out of plane, wavy, bumpy, or irregular, follow the existing contour. Do not create a flat surface area in an irregular surface plane.

Trim the edges of the new plaster, where it adjoins the old plaster. The surface of the blocking coats should be slightly depressed below the existing plaster surface.

Finish coat-Use a quick-setting material whenever possible. After blocking coat(s) are set, apply the finish coat, flush to the edges of the existing plaster, and trowel or texture to match the existing surface. After the finish coat has set, wash the area with clean water to remove any plaster residue. When dry, rub the surface with a clean rag to remove traces of white or gray stain.

Never retard the setting time of patching materials. Prepare multiple, smaller batches of fast-setting material. Do not retemper patching material to do all the work with one batch.

Use the same material proportions for blocking coats and finish coats. Do not use an overly rich mix.

Use an appropriate polyvinyl acetate, styrene-butadiene, or acrylic liquid bonding compound in the plaster mix, integrally mixed with the mixing water, and in a proportion recommended by the manufacturer.

15.2-Cracks or fractures

Because of the complexity and uncertainties associated with the cracking of portland cement plaster, some minor fracturing must be expected as normal.

The pattern, location, length, width, depth, and frequency of fractures are often indicators of the cause or source of concentrated stresses. Spalling of the finish plaster coat along the fracture usually indicates active movement of the structure. Offsets in plane on either side of the fracture are evidence that stresses are being transferred to the plaster from somewhere behind the plaster membrane.

Cracks may be hairline or larger in size. Static hairline cracks may be filled and bridged with conventional film-forming acrylic or styrene-butadiene latex paints or coatings. Dynamic hairline cracks can be filled and bridged with elastomeric acrylic or latex coating systems. Refer to coating manufacturers for recommendations. Larger cracks may be prepared and filled with elastomeric sealants. For specific sealant selections and directions for use, consult the sealant manufacturers.

15.3-Texture variations

Cold joints, float, and spray texture variations, uneven aggregate distribution in exposed aggregate finishes, washouts, blisters, turtle-backs, buckles, blemishes, slobbers, puddling-each has a particular method of correction. These may be remedied by a variety of actions or a combination of them such as bonding and application of a finish coat, application of a partial finish coat such as lacing with a skip trowel or dash texture, local patching, scraping back, etc. Generally, imperfections in the base coat or flaws in the finish coat will reflect through and not be corrected by applying a subsequent dash finish coat.

Color variations include shading, mottling, texture, holidays, glazing, puddling, foreign material embedment or stains, leaching, mildew/mold/algae growth, moisture/absorption variations, sulfate migration, efflorescence, etc. Minor discolorations may be remedied by fog-coating, application of a brush-coat, or paint coating. A colored stucco finish may require the application of a new finish coat after the substrate deficiencies have been corrected.

CHAPTER 16-TOOLS AND EQUIPMENT

Tools categorized by function are:

16.1—Scaffolds

Scaffolds are necessary to provide working platforms to bring the workers within reach of the surfaces to be lathed or plastered. Scaffolds are rigid planked frames based on the ground. There are also mechanized scaffolds such as aerial lifts, rail-mounted scaffolds, suspended or slung scaffolds, man lifts and rolling towers. To be safe they must be steady and at a proper distance from the plastering surface.

16.2-Lather's tools

Lather's tools include cutting, measuring, and leveling tools, and other specialty tools needed to shape and attach lath to framing supports or solid bases. The most common are hatchet, snips, nippers, staple guns, screw guns; and electric and powder-driven tools.

16.3-Plastering tools

16.3.1 *Mixing*-Plaster mixing tools include: shovel, hoe, mortar box, wheelbarrow, bucket, drill motor-driven mixers, and gas or electrically driven plaster mixers.

16.3.2 *Conveyance took*-Plaster conveyance tools and equipment include: hods, wheelbarrows, and buckets that transport the plaster to a mortar board for hand application. A plaster pump can deliver plaster from the mixer and spray it directly to the plastering surface through a hose system. A plaster pump may also be used to convey mortar from the mixer to a mortar board for hand application.

16.3.3 *Application*-Hand a pplication of plaster is achieved using the historic hawk and trowel. Hawks are hand-held square metal platforms 8 to 14 in. in size that are used to hold a working quantity of plaster. Trowels are used to apply plaster to various substrate. They are classified by size, shape, and construction material. Shapes include the margin, pointing, pool, pipe, midget, and common plasterer's trowel. Trowels are fabricated from steel. stainless steel, aluminum, magnesium, wood, plastic, fiberglass, and other composite materials.

A plaster pump blows the mortar directly on the lath or other base. Most pumps require an air compressor matched to the size of the pump. For specialty work, rock guns are used to embed special aggregate into the plaster surface. Dash guns spray on special finish textures. Glitter guns throw glitter, chips, or other special effect materials into a plastic bedding coat.

16.3.4 *Contouring tools*-For contouring or straightening plaster, a rod, straightedge, darby, angle float, plaster plane, level, or other specialty tool may be used.

16.3.5 *Scratching tools*-Scratching or scoring tools create keying striations or furrows in the plaster.

16.3.6 *Compacting tools*-Hard surface floats are used for compacting the brown or leveling coat.

16.3.7 *Texturing tools*-The sponge float, brush, combing tool, templates, and other specialized tools are used for achieving finish textures.

16.3.8 *Scraping toots*-Carving or scraping tools are used for special surface effects in plaster.

16.3.9 *Cleaning tools*-Cleaning fresh plaster from surfaces can be done with a water-soaked dash brush or a water hose followed up with a clean sponge. In some cases, high-pressure hot-water cleaning machines or abrasive cleaning equipment are needed to remove hardened plaster.

CHAPTER 17-REFERENCES

17.1-Recommended references

The documents of the various standards-producing organizations referred to in this document are listed below with their serial designation.

American Concrete Institute

201 Guide to Durable Concrete

American Society for Testing and Materials

A 525 Specification for General Requirements for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process

A 641 Specification for Zinc Coated (Galvanized) Carbon Steel Wire

C 35 Specification for Inorganic Aggregates for Use in Gypsum Plaster

C 91 Specification for Masonry Cement

C 144 Specification for Aggregate for Masonry Mortar

C 150 Specification for Portland Cement

C 206 Specification for Finishing Hydrated Lime

C 207 Specification for Hydrated Lime for Masonry Purposes

C 260 Specification for Air-Entraining Admixtures for Concrete

C 494 Specification for Chemical Admixtures for Concrete

C 595 Specification for Blended Hydraulic Cements

C 631 Specification for Bonding Compounds for Inter-

ior Plastering
C 780 Test Method for Reconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C 841 Specification for Installation of Interior Lathing and Furring
C 847 Specification for Metal Lath
C 856 Practice for Petrographic Examination of Hardened Concrete
C 897 Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters
C 926 Specification for Application of Portland Cement-Based Plaster
C 932 Specification for Surface-Applied Bonding Agents for Exterior Plastering
C 933 Specification for Welded Wire Lath
C 979 Specification for Pigments for Integrally Colored Concrete
C 1032 Specification for Woven Wire Plaster Base
C 1063 Specification for Installation of Lathing and Furring for Portland Cement-Based Plaster
C 1084 Test Method for Portland Cement Content of Hardened Hydraulic Cement Concrete
C 1116 Specification for Fiber-Reinforced Concrete and Shotcrete
D 98 Specification for Calcium Chloride
D 4258 Practice for Surface Cleaning Concrete for Coating
D 4259 Practice for Abrading Concrete
D 4261 Practice for Surface Cleaning Concrete Unit Masonry for Coating
D 4262 Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces
D 4263 Test Method for Indicating Moisture in Concrete by the Plaster-Sheet Method

International Conference of Building Officials

Uniform Building Code Chapter 47 - Installation of Wall and Ceilings Coverings

Federal Specifications
Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

17.2-General References
Portland Cement Plaster (Stucco) Manual
EB049M, Portland Cement Association, Skokie, Ill. 1980

Manual of Lathing and Plastering, John Deihl, AIA, 1960, The Lathing and Plastering Industry Committee

The above publications may be obtained from the following organizations:

American Concrete Institute
P.O. Box 9094
Farmington Hills, MI 48331-9094

American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103

International Conference of Building Officials
5360 South Workman Mill Road
Whittier, CA 90601

GLOSSARY OF PLASTERING TERMS

A

Accessories:

Arch corner bead-Comer bead so designed that it can be job-shaped for use on arches.

Casing bead -Sometimes called a plaster stop, this bead is used where plaster is discontinued, around openings, thus providing a ground, where the plaster adjoins another material; and to form the perimeter of a plaster membrane or pane.

Clips:

Beam clip-Formed wire section used to attach lath to flanges of steel beams.

Casing clip -Formed metal section which puts pressure on a casing bead to assure rigid positioning.

Clip for control of movement-Flexible, resilient metal section separating the plaster membrane from supports to reduce plaster cracking due to structural movement (and to reduce sound transmission).

Corner bead clip-Metal section used, where necessary, to provide an extension for attachment of various types of corner beads.

End clip-Metal section used to secure ends and edges of gypsum lath.

Furring clip -Metal section for attaching cross furring to main runners.

Individual stud clip-Formed metal section for use where a floor runner is impractical.

Lath clip (generic)-Metal section to secure lath to supports.

Metal base clip-Formed metal section to which is attached a metal base for partitions or walls.

Metal lath clip-Formed wire section for fastening metal lath to flanges of steel joists.

Sound transmission clip-Flexible, resilient metal clip used to decrease sound transmission through partition and floor assemblies (also serves to lessen plaster cracking resulting from structural movement).

Starter clip-Metal section used at floor, or initial course of gypsum lath.

Wall furring base clip-Formed metal section used to attach metal base to furred walls.

Cornerite-Corner reinforcement for interior plastering where the plaster base is not continuous around an internal corner/or angle.

Inserts:

Metal arch-Sheet steel-formed arch for use as base (lath) or corner reinforcement at arched openings in partitions.

Metal base-Fabricated integral metal section which also serves as a ground for the plaster (attached to framing member or masonry).

Metal corner bead-Fabricated metal with flanges and nosings at juncture of flanges; used to protect or form arrises.

Partition cap-Formed metal section for use at the end of a free-standing solid partition to provide protection of plaster; also as a stair rail cap, mullion cover, light cove cap, etc.

Shoe-Formed metal section used in attaching metal studs to floor and ceiling tracks.

Track:

Ceiling track, ceiling runner track or ceiling runner-Formed metal section, anchored to the ceiling, into which metal studs for hollow or solid partitions are set; a formed metal section to which lath is attached for studless partitions; a metal channel or angle used for anchoring the partition to the ceiling.

Floor track, floor runner truck or floor runner-Formed metal section, anchored to the floor, into which metal studs for hollow or solid partitions are set; a formed metal section into which lath is inserted for studless partitions; a wood member into which lath is inserted for studless partitions; a metal channel used for anchoring the partition to the floor.

Acid etching-The cleansing and controlled dissolving of the surface components.

Angle iron-Metal section sometimes used as main runners in lieu of channels.

Arris-Sharp edge, forming an external corner at the junction of two surfaces.

Atomizer-Device by which air is introduced into material at the nozzle to regulate the texture of machine-applied plaster.

B

Bead

a) Metal-See metal corner bead.

b) Plaster-Member of run, or precast plaster moldings.

Bedding coat-Plaster coat that receives aggregates or other decorative material impinged into its surface before it sets.

Blocking (or blocking in)-To fill the thickness of the base coat plaster from the substrate up to the back side of the finish coat.

Brackets-Formed shapes of channel or pencil rod, used in erecting furred assemblies.

Bridging-Section sized to fit inside the flanges of studs and channels to stiffen construction.

Brown coat-Second coat in a three-coat plaster application.

Buckles-Raised or ruptured spots in plaster that usually crack and possess no bond.

Bull nose-External angle which is rounded to eliminate a sharp arris or corner; may be run in plaster or obtained by use of a metal accessory.

Butterflies-Color imperfections in lime finish-plaster.

Butterfly reinforcement-Strips of metal reinforcement placed diagonally over the plaster base at the corner of openings before plastering.

C

Ceilings

Contact ceiling-Ceiling composed of lath and plaster secured in direct contact with the construction above, without the use of runner channels or furring.

Furred ceiling-Ceiling composed of lath and plaster attached by means of steel channels, or rods, or furring strips in direct contact with the construction above.

Suspended ceiling-Ceiling composed of lath and plaster and steel channels suspended from, but and not in direct contact with, the floor or roof construction above.

Channels-Hot-rolled or cold-rolled steel sections, used for furring and carrying channels or runners, and as studs. Channels shall have various weights per 1000 lineal feet depending on size. Refer to ASTM C 1063.

Channels, currying-Heaviest integral supporting member in a ceiling. Carrying channels, or main runners, are supported by hangers attached to the building structure and in turn support furring channels or rods to which lath is fastened.

Channels, furring-Smaller horizontal member of a suspended ceiling, applied at right angles to the underside of carrying channels and to which lath is attached; the smaller horizontal member in a furred ceiling; in general, the separate members used to space lath from any surface or member over which it is applied.

Chase-Space provided in a masonry or concrete wall for pipes, conduit, etc.

Chip cracks-Similar to check cracks, except that the bond has been partially destroyed; sometime referred to as egg-shelling.

Coat-A thickness of plaster applied in a single operation.

Cohesion-Ability of a material to cling to itself.

Control (expansion-contraction) joint-A designated separation in the system materials that allows for movement caused by expansion and contraction of the system. The construction of the separation is accomplished by one of the following methods: 1) manufactured devices suitable for this application, or 2) by field fabrication of suitable materials.

Cove-Curved concave surface.

Cross furring-Smaller horizontal members attached at right angles to the underside of main runners or other structural supports. See Channels, furring; see also Furring.

Cross scratching-Scratching of the first coat in two directions to provide a mechanical bond between coats.
Curtain wall-Non-load-bearing exterior wall, supported by the structural elements of a building.

D

Dado-Lower part of a wall usually separated from the upper by a molding or other device.
Dash texture-Finish coat of thick cement plaster hand-dashed or machine blown onto a well-prepared, uniformly plane surface of brown-coat plaster. (Also called spatterdash.)
Diamond mesh-One of the common types of metal lath having a characteristic geometrical pattern produced by slitting and expansion of metal sheets.
Dot-Small projection of basecoat plaster placed on a surface and faced out between grounds to assist the plasterer in obtaining the proper plaster thickness and surface plane; occasionally pieces of metal or wood applied to plaster base at intervals as spot grounds to gauge plaster thickness. See Screeds, Plaster.
Double back (or double up) -Method of plastering characterized by application in successive operations with no setting or drying time between coats.

E

Elastomer-Any macromolecular material (such as rubber or a synthetic material having similar properties) that returns rapidly to approximately the initial dimensions and shape after substantial deformation by a weak stress and release of stress.
Elevation-Drawing of the interior/exterior vertical sections or sides of a building showing heights, widths, etc.
Enrichments-Any cast ornament that cannot be executed by a running mold.
Expanded metal lath-See Diamond Mesh.

F

Fibers-Alkali-resistant fibers used as secondary reinforcement of portland cement plaster.
Fireproofing membrane- Lath and plaster system which is separated from the structural steel members, in most cases by furring or suspension, to provide fireproofing.
Fog coat-Light coat of cement and water, with or without aggregate or color pigment, applied by machine spray to improve color consistency.
Framing-Structural members such as columns, beams, girders, studs, joists, headers, trusses, etc.
Fresco-Art or decorative method consisting of applying a water-soluble paint to freshly spread plaster before it dries.

G

Galvanized steel-Steel metal coated with zinc to inhibit rusting.
Glazing-Condition created by the fines of a machine dash texture plaster traveling to the surface and producing a flattened texture and shine or discoloration. This may be caused by the basecoat being too wet or the acoustical mortar being too moist. Glazing occurs in hand application when mortar being worked is excessively wet.
Glitter-Reflective material such as glass, diamond dust, or small pieces of variously colored aluminum foil projected into the surface of wet plaster or paint as a decorative treatment.
Grillage-Framework composed of main runner channels and furring channels to support ceilings.
Ground-Wood or metal strips attached to the framing or plaster base with the exposed surface acting as a gage to determine the thickness and plane of the plaster.
Gusset-Wood or metal plate affixed over joints (such as truss members) to transfer stresses between members.

H

Hangers-Vertical members which carry the steel framework of a suspended ceiling; or the vertical members which support furring under concrete joist construction; or the wires used in attaching lath directly to concrete joist construction.
Hog ring-Heavy galvanized wire staple applied with a pneumatic gun which clinches it in the form of a closed ring around a stud, rod, pencil rod, or channel.

J

Joining-Juncture of two separate plaster applications of the same coat, usually within a single surface plane.

L

Lath-Base to receive plaster, generally secured to framing or furring members. See Diamond Mesh.
Line wire-See String Wire.

M

Main runners-Heaviest integral supporting member in a suspended ceiling. Main Runners, or Carrying Channels, are supported by hangers attached to the building structure, and in turn support furring channels or rods to which lath is fastened.
Marble chips-Graded aggregate made from crushed marble to be embedded in a soft plaster coat to produce marblecrete.
Mechanical application-Application of plaster by mechanical means, generally pumping and sprayings, as distinguished from hand placement.
Mechanical trowel-Motor-driven tool with revolving blades used to produce a denser finish coat than hand troweling.
Metal lath-expanded-Metal lath is of three types, desig-

nated as Diamond Mesh (also called Flat Expanded Metal Lath), Rib, or Sheet. Metal lath is slit and expanded, or slit, punched, or otherwise formed, with or without partial expansion, from copper alloy or galvanized steel coils or sheets. Metal lath is coated with rust-inhibitive paint after fabrication, or is made from galvanized sheets.

a) Diamond mesh or flat expanded metal lath-This term is used to indicate a metal lath slit and expanded from metal sheets or coils into such a form that there will be no rib in the lath.

b) Self-furring metal lath-Metal formed with portions of it extending back from the face of the lath so that it is separated at least ¼ in. from the background to which it is attached; painted or galvanized.

c) Flat rib metal lath-Combination of expanded metal lath and ribs in which the rib has a total depth of approximately ⅛ in. measured from top inside of the lath to the top side of the rib; painted.

d) ⅜ in. rib metal lath-Combination of expanded metal lath and ribs of a total depth of approximately ⅜ in., measured from top inside of the lath to the top side of the rib.

e) ¾ in. rib metal lath-Combination of expanded metal lath and ribs of a total depth of approximately ¾ in., measured from the top inside of the lath to the top side of the rib, painted.

f) Paper-backed metal lath or expanded stucco mesh-Factory-assembled combination of any of the preceding defined types of metal lath or expanded stucco mesh with paper, or other backing; the assembly being used as a plaster or stucco base.

g) Sheet lath-Metal lath, slit, or punched or otherwise formed from metal sheets; painted.

Mitre-Diagonal joining of two or more molding at their intersection.

N

Nailing channel-Fabricated from steel not lighter than 25-gage with slots to permit attachment of lath by means of ratchet-type annular nails or other satisfactory attachments.

0

Orifice-Attachment to the nozzle on the hose of plastering machines of various shapes and sizes that may be changed to help establish the pattern of the plaster as it is projected onto the surface being plastered.

P

Perimeter relief-Construction detail which allows for building movement. Gasketing materials which relieve stresses at the intersections of wall and ceiling surfaces.

Plaster membrane-Total of all plaster coats, including metal reinforcement or metal plaster base.

Plastering machine- Mechanical device by which plaster mortar is conveyed through a flexible hose to deposit the plaster in place; also known as a plaster pump or plastering gun. Distinct from "gunite" machines in which the plaster or concrete is conveyed, dry, through a flexible hose and hydrated at the nozzle.

Plastic cement-Special cement manufactured expressly for the plaster industry.

Portland cement plaster-Plaster with portland cement used as part or all of the cementitious material.

Power-driven fastener-Fastener attached to steel, concrete, or masonry by a powder-charged cartridge or by manual impact.

Puddling-Condition of mechanical dash textures resulting in a glazed texture deviation or discoloration caused by holding the plastering machine nozzle too long in one area.

R

Racking-Lateral stresses exerted on an assembly in the plane of a panel.

Relief-Ornamented prominence of parts of figures above or below a plane surface.

Return-Turn and continuation of a wall or projection in an opposite or different direction.

Rock gun-Device for propelling aggregate onto a soft bedding coat in applying marblecrete.

S

Saddle tie-Specific method of wrapping hanger wire around main runners; also of wrapping tie wire around the juncture of main runner and cross furring.

Scarifier-Tool with flexible steel tines used to scratch or rake the unset first coat of plaster surface.

Scoring-Grooving, usually horizontal, of portland cement plaster scratch coat to provide mechanical bond for the brown coat. Also a decorative grooving of the finish coat.

Screed-Plaster or an accessory used to establish a flat time plane and uniform plaster thickness.

Scratch coat-First coat of plaster or stucco; usually cross-raked or scratched to form a mechanical key with the succeeding brown coat.

Shielding-Method of protecting adjacent work by positioning temporary protective sheets of rigid materials; particularly used for machine application of plaster.

Slobber-Heavy splatter.

Staff-Plaster casts of ornamental details made in molds and reinforced with fiber. Usually wired or nailed or stuck into place.

Stiffener-Horizontal metal shape tied to vertical member (studs or channels) or partitions or walls to brace them.

String wire-Soft annealed steel wire placed horizontally around a building of open stud construction with support waterproofing paper or felt.

Suction-Capacity for absorption possessed by a substrate or plastered surface.

T

Three-coat plastering-Application of plaster in three successive coats.
Tie wire-soft annealed steel wire used to join lath supports, attach lath to supports, attach accessories, etc.
Ties-There are two types used for the attachment of lath: a) the butterfly tie, which is formed by twisting the wire and cutting so that the two ends extend outward in opposite directions, and b) the stud tie, which is twisted and cut at the twist. See Saddle ties.
Turtle back

1. Term used synonymously with blistering, and
2. Term used regionally to denote a small localized area of wind crazing.

Two-coat plastering-The application of plaster in two successive coats.

W

Wainscot-Lower portion of an interior wall when it is finished differently from the remainder of the wall.
Washout-Lack of proper coverage and texture buildup in machine dash-textured plaster caused by the mortar being too soupy.
Wire (cloth) lath-Plaster reinforcement of wire not lighter than 19 gage, 2% meshes per in. and coated with zinc or rust-inhibitive paint. (Not to be used as reinforcement of exterior portland cement.)

Z

Zinc alloy-Metal made of 99 percent zinc and only enough alloying elements to provide durability and formability.

CONVERSION FACTORS

1 in. = 25.4 mm
1 lb/in^2 = 6.8 kPa
1 lb/yd^3 = 0.59 kg/m^3

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