PLASTER AND STUCCO FOR CONCRETE MASONRY

INTRODUCTION

Portland cement-based plaster has many useful applications: as a moisture resistant coating for concrete masonry walls; as an interior wall finish in residential and commercial structures; and as an exterior architectural treatment for buildings of all types.

The terms cement plaster and cement stucco are used interchangeably. They both describe a combination of cement and aggregate mixed with a suitable amount of water to form a plastic mixture that will adhere to a surface and preserve the texture imposed on it.

When freshly mixed, plaster is a pliable, easily workable material. It can be applied either by hand or machine in two or three coats, although two-coat applications are more typical when plaster is applied to newly constructed concrete masonry.

While plaster may be used as an interior or exterior finish for most building materials, some type of metal reinforcement or mechanical keying system is usually required to effectively attach the plaster to the substrate. Concrete masonry, however, provides an excellent base for plaster without the need for reinforcement. Since block is manufactured of the same cementitious material as that in the plaster, the two have a natural affinity.

MATERIALS

Of primary importance to the performance of the finished surface is the selection and use of proper materials. Each must be evaluated on its ability to provide serviceability, durability, and satisfactory appearance. Standard Specification for Application of Portland Cement-Based Plaster, ASTM C 926 (ref. 3) includes specifications for materials for use in plaster.

Cement

Cement should comply to one of the following product specifications:

Blended hydraulic cement —ASTM C 595 (ref. 4)
Types IP, IP(M), IS, IS(M), and their air-entrained counterparts IP-A, IP(M)-A, IS-A, IS(M)-A

Masonry cement—ASTM C 91 (ref. 5) Types M, S, N

Portland cement—ASTM C 150 (ref. 6)
Types I, II, III, and their air-entrained counterparts IA, IIA, IIIA

Plastic cement—UBC 25-1 (ref. 1)

White portland cement—ASTM C 150 (ref. 6) Types I, IA, III, IIIA

Aggregates

Aggregates used in plaster should conform to the chemical and physical requirements of ASTM C 897, Standard Specification for Aggregate For Job-Mixed Portland Cement Plasters (ref. 2), except as noted below. Recommendations for gradation of the sand to be used in the base coat are listed in Table 1.

Aggregates used for finish coats need not comply with the gradation requirements of ASTM C 897. Various sizes and

Table 1—Sand Gradation for Base-Coat Plaster

Retained on U. S. standard sieve	Cumulative weight percent retained	
	Minimum	Maximum
No. 4	----	0
No. 8	0	10
No. 16	10	40
No. 30	30	65
No. 50	70	90
No. 100	95	100
No. 200	97	100

shapes can be evaluated with test panels to obtain special textures or finishes. As a starting point, all aggregates for finish-coat plaster should be below a No. 16 sieve and uniformly graded. Uniform gradation produces plaster that is easier to apply. If necessary, larger aggregate may be added to obtain the desired appearance.

MIXTURES

Properly proportioned mixtures can be recognized by their workability, ease of application, adhesiveness to the base, and resistance to sagging.

The combinations of cementitious materials and aggregates shown in Table 2 have proven to provide satisfactory performance. These proportions are recommended for first and second coat applications.

Considerations in selecting the plaster mix include suction of the masonry, its surface irregularities, climate extremes, extent of surface exposure, and method of application. For economy and simplicity, it is better to select the same plaster type for both scratch (first) and brown coat (second coat in a threecoat application) applications, adjusting the proportions for the brown coat to allow for a larger aggregate to cement ratio.

The finish coat can be varied in appearance by changing the size and shape of the aggregate, by adding color, by changing the consistency of the finish mix, and by the application method. For the finish coat, a factory prepared mixture may be used or the finish coat may be proportioned and mixed at the jobsite. Job-mixed finish coat plaster will provide a truer color and more pleasing appearance if white portland cement is used in conjunction with a fine-graded, light-colored sand. Recommendations for job-mixed finish coat proportions are listed in Table 3.

Table 2—Base-Coat Plasters (Proportions, Parts by Volume[1])

Plaster type	Cementitious Materials[2]					Sand[3]	
	Portland cement or blended cement	Lime	Masonry cement		Plastic cement	First coat4 (scratch)	Second coat[4] (brown)
			N	M/S			
CM	1			1		2½ to 4	3 to 5
CL	1	¾ to 1½				2½ to 4	3 to 5
M				1		2½ to 4	3 to 5
P					1	2½ to 4	3 to 5
MS				1		2½ to 4	3 to 5

[1] A range of lime and sand contents allows for adjusting each mix to optimize workability using local materials.
[2] The type of cement selected should be determined by weather conditions durin plastering, availability of materials, and anticipated exposure.
[3] The same or a greater quantity of sand than that used in preparing the scratch coat should be used while preparing the brown coat.
[4] Volume of sand per sum (total amount) of cementitious materials used.

Table 3—Job-Mixed Finish-Coat Plaster (Proportions, Parts by Volume[1])

Plaster type[2]	Cementitious Materials					Sand[3]
	Portland cement or blended cement	Lime	Masonry cement		Plastic cement	
			N	M/S		
F	1	¾ to 1½				1½ to 3
FL	1	1½ to 2				1½ to 3
FM				1		1½ to 3
FP					1	1½ to 3
FCM	1			1		1½ to 3
FMS				1		1½ to 3

[1] Coloring compounds should be added by weight of portland cement and as an addition to mixtures given.
[2] Surfaces subjected to abrasion should be plastered with plaster type F, FP, or FPM.
[3] Volume of sand used per sum (total amount) of cementitious materials for finish coat. Quantity and gradation are dependent on surface texture desired.

The success of plastering depends on proper batching and mixing of the individual and combined materials. Water is placed in the mixer first, after which half of the sand is added. Next the cement and any admixtures are added. Finally, the balance of the sand is added and mixing is continued until the batch is uniform and of the proper consistency, which usually takes 3 or 4 minutes.

Although batching by shovelfuls remains the most commonly used method in the field, shovelful batching should be checked daily by volume measures to establish both the required number of shovelfuls of each ingredient and the volume of mortar in the mixer when a batch is properly proportioned. Water additions should also be batched using containers of known volume. Proper mixing should result in a uniform blend of all materials.

PLASTER APPLICATION

Open textured concrete masonry units, laid with flush (non-tooled) joints, should be specified on walls intended to be plastered. The open texture promotes a good mechanical bond between the plaster and the masonry. New concrete masonry walls should be properly aligned and free from any surface

contamination, such as mortar droppings or sand. It is important that the wall be properly cured and carrying almost all of its design dead load before the plaster is applied. Existing masonry walls should be inspected for alignment, and any coatings or surface treatments other than portland cement paint be should removed by sandblasting prior to plastering.

Plaster may be applied by hand or machine in two or three coats in accordance with the thicknesses given in Table 4. Two-coat application is most often used when plaster is applied directly to concrete masonry, and for horizontal (overhead) plaster application.

The scratch coat can be applied either from the bottom to the top of the work area, or from top to bottom. The plaster must be applied with sufficient force to fully adhere it to the masonry. Excessive troweling or movement of the scratch coat must be avoided, because too much action will break the bond between the plaster and masonry. The applied plaster must be brought to the required thickness and the surface made plumb. The thickness is established by the use of screeds and grounds. A rod or straightedge is used to even the surface when the area between the screeds and grounds is filled with plaster. The rod can bear on the screeds or contact the grounds and be moved over the surface, cutting off high spots and showing up the hollow spaces, which must be filled and rodded again.

Scratch-coat plasters are scored or scratched to promote mechanical bond when the brown coat is applied. The scratch coat should be scored in a horizontal direction; shallow scratching is adequate.

Brown-coat plasters are applied, rodded, and floated to even the surface, provide a uniform suction throughout the basecoat plaster, and provide a desirable surface for the finish coat.

The brown coat is applied in sufficient thickness to bring the surface to the proper plane. A few minutes after the plaster has been applied, the surface is rodded to the desired plane. The plaster thickness is properly gaged with plaster screeds or wood slats of proper thickness as the guides. After rodding, the surface is floated to give it the correct surface texture.

Floating of the brown coat is the most important part of plastering. Floating must be done only after the plaster has lost sufficient moisture so that the surface sheen has disappeared but before the plaster has become so rigid that it cannot be moved under the float. This interval is critical, since the degree of consolidation that occurs during floating influences the shrinkage-cracking characteristics of the plaster.

The full thickness of the base coats should be applied as rapidly as the two coats can be put in place. The second coat should be applied as soon as the first coat is sufficiently rigid to resist the pressures of second-coat application without cracking. Under certain conditions this may mean applying both first and second coats in a single day. The short delay, or even no delay, between the first and second coats promotes more intimate contact between them and more complete curing of the base coat. No stoppage of plaster should occur within a panel. The finish coat is applied to a predamped, but still absorptive, base coat to a thickness of about 1/8 in. (3.2 mm). The finish coat is applied from the top down and the whole wall surface must be covered without joinings (laps or interruptions). Table 4 summarizes the recommended nominal plaster coat thicknesses for both two and three coat work.

Differential suction between the masonry units and mortar joints may cause joint patterns to be visible in two coat applications if the first coat is too thin. This may also occur if the walls are plastered while the units contain excessive moisture.

Table 4—Nominal Plaster Thickness for Three- and Two-Coat Work[1,2] on Concrete Masonry Walls, in. (mm)

	First coat	Second coat	Third coat	Total
Three-coat work[3]:	1/4 (6)	1/4 (6)	1/8 (3)	5/8 (16)
Two-coat work:	3/8 (9.5)	1/8 (3)	—	1/2 (12.5)

[1] Where a fire rating is required, plaster thickness shall conform to the applicable building code or to an approved test assembly.
[2] Where masonry surfaces vary in plane, plaster thickness required to produce level surfaces will not be uniform.
[3] For exposed-aggregate finishes, the second (brown) coat may become the bedding coat and shall be of sufficient thickness to receive and hold the aggregate specified. The total thickness shown in Table 4 shall be achieved.

CONTROL JOINTS

Cracks can develop in plaster from a number of causes: drying shrinkage stresses; building movement; foundation settlement; intersecting walls, ceilings, and pilasters; weakened sections in a wall from a reduction in service area or cross section because of fenestration; severe thermal changes; and construction joints.

To prevent such cracking, install control joints in the plaster coat directly over and aligned with any control joints in the base. Normally, cracking will not occur in plaster applied to uncracked masonry bases if the plaster bonds tightly to the base structure. If excessive cracking does occur, the application (particularly floating) procedure may not have provided adequate bond of plaster to concrete masonry. Altering application procedures or mechanically anchoring the plaster to the concrete masonry surface with mesh may be required.

CURING

To obtain the best results from the cementitious materials in cement plaster, moisture must be kept in the plaster for the first few days after application. The base coat should be moist cured until the finish coat is applied. Generally, fogging the surface with water at the start and again at the end of the work day will suffice. If it is hot, dry, and windy, the plaster surface should be moistened and covered with a single sheet of polyethylene plastic, weighted or taped down to prevent water loss through evaporation.

Remedies for Common Problems

Observation	Cause	Prevention
Cement floats on water during batching.	Cement additive makes cement hydrophobic (water-fearing).	Mix longer before final water addition.
Cementitious material contains lumps.	Improper protection of water sensitive materials.	Keep materials high and dry. Mix with low water content until lumps disappear.
Plaster froths in mixer.	Excessive water; improper admixture; prolonged mixing; or cold temperatures.	Reduce water; eliminate admixture; mix 3 to 4 minutes; or heat water.
Plaster stiffens immediately after application to concrete masonry base.	Concrete masonry base is too dry or water retention of plaster is too low.	Moisten base prior to plaster application.
Efflorescence appears on scratch-coat surface.	High water content plaster used; cold weather; or excessive delay between coats.	Adjust water content; heat material(s); or shorten time between coats.
Finish coat blisters.	Mix too rich; excessive water during finishing; or finishing with improper tool.	Adjust mix using more sand and less water; float at proper time.

Immediately before finish-coat application, the base coat should be moistened. This moisture absorbed by the base coat and the ambient relative humidity provides total curing of the finish-coat plaster (particularly colored finish coats) so that it is not necessary to further moist-cure the finish coat.

MAINTENANCE OF PLASTER

Minimal care will keep plaster attractive for many years. Washing will keep the surface clean and the color bright.

Washing plaster wall surfaces consists of three steps:

1. Prewet the wall, saturating it. Start at the bottom and work to the top.
2. Use a garden hose to direct a high-pressure stream of water against the wall to loosen the dirt. Start at the top and wash the dirt down the wall to the bottom.
3. Flush remaining dirt off the wall with a follow-up stream.

Prewetting overcomes absorption and prevents dirty wash water from being absorbed and dulling the finish. A jet nozzle on a garden hose will usually clean effectively. Do not hold the nozzle too close to the surface because the highpressure stream of water may erode the surface.

Chipped corners and small spalls can be patched with premixed mortar. The patch area should be wetted before applying plaster. Prepare premixed mortar by adding water and mixing to a doughy consistency, then trowel into the patch area, and finish to match the texture of the surrounding surface.

A fresh, new look can be given to any exterior plaster wall by applying a surface treatment of paint, portland cement paint, or other coating. Portland cement paints are mixed with clean water to a brushable consistency and laid on heavily enough to fill and seal small cracks and holes. The surface should be dampened immediately before application.

REFERENCES

1. *Plastic Cement*, Uniform Building Code Standard 25-1, International Conference of Building Officials (ICBO), 1994.
2. *Standard Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters*, ASTM C 897-00. American Society for Testing and Materials, 2000.
3. *Standard Specification for Application of Portland Cement-Based Plaster*, ASTM C 926-98a. American Society for Testing and Materials, 1998.
4. *Standard Specification for Blended Hydraulic Cements*, ASTM C 595-02. American Society for Testing and Materials, 2002.
5. *Standard Specification for Masonry Cement*, ASTM C 91-01. American Society for Testing and Materials, 2001.
6. *Standard Specification for Portland Cement*, ASTM C 150-00. American Society for Testing and Materials, 2000.

ABOUT CMHA

The Concrete Masonry & Hardscapes Association (CMHA) represents a unification of the Interlocking Concrete Pavement Institute (ICPI) and National Concrete Masonry Association (NCMA). CMHA is a trade association representing US and Canadian producers and suppliers in the concrete masonry and hardscape industry, as well as contractors of interlocking concrete pavement and segmental retaining walls. CMHA is the authority for segmental concrete products and systems, which are the best value and preferred choice for resilient pavement, structures, and living spaces. CMHA is dedicated to the advancement of these building systems through research, promotion, education, and the development of manufacturing guides, design codes and resources, testing standards, and construction practices.