

S156-19

IBC: 2109.2.4.8, 2109.2.4.8.1 (New), 2109.2.4.8.2 (New), 2109.2.4.8.3 (New), 2109.2.4.8.4 (New), 2109.2.4.8.5 (New), 2109.2.4.8.6 (New)

Proposed Change as Submitted

Proponents: K. Ben Loescher, AIA, Loescher Meachem Architects, representing Self (bloescher@lmarchitectsinc.com); Martin Hammer, representing Martin Hammer, Architect (mfhammer@pacbell.net); David Eisenberg, representing DCAT (strawnet@gmail.com)

2018 International Building Code

Delete and substitute as follows:

2109.2.4.8 Exterior finish. ~~Exterior walls constructed of unstabilized adobe units shall have their exterior surface covered with not fewer than two coats of Portland cement plaster having a minimum thickness of $\frac{3}{4}$ inch (19.1 mm) and conforming to ASTM C926. Lathing shall comply with ASTM C1063. Fasteners shall be spaced at 16 inches (406 mm) on center maximum. Exposed wood surfaces shall be treated with an approved wood preservative or other protective coating prior to lath application.~~

2109.2.4.8 Exterior finish. Exterior finishes applied to adobe masonry walls shall be of any type permitted by this code, and shall comply with the provisions of this section and with Chapter 14, except where stated otherwise in this section.

Add new text as follows:

2109.2.4.8.1 Purpose, and type. Unstabilized adobe masonry walls shall be finished on their exterior with a plaster of any type in this section to provide protection from weather in accordance with this code.

2109.2.4.8.2 Vapor retarders and vapor permeance. Class I and II vapor retarders shall not be used on any adobe masonry wall, nor shall any other material be used that has a vapor permeance rating of less than 5 perms.

2109.2.4.8.3 Plaster thickness and coats. Plaster applied to adobe masonry shall be not less than 7/8" (22 mm) and not greater than 2 inches (51 mm) thick. Plaster shall be applied in not less than two coats.

2109.2.4.8.4 Plaster application. Plaster shall be applied directly to adobe masonry walls without any type of membrane to facilitate transpiration of moisture from the masonry units, and to secure a mechanical bond between the masonry and plaster.

2109.2.4.8.5 Lath for plaster. Lath shall be provided for all plasters, except as otherwise not required in this section. Fasteners shall be spaced at 16 inches (406mm) on center maximum. Metal lath shall comply with ASTM C1063, as modified by this section, and shall be corrosion resistant. Plastic lath shall comply with ASTM C1788, as modified by this section.

2109.2.4.8.6 Cement plaster. Cement plaster shall conform to ASTM C926 and shall comply with Chapter 25, except that the proportion of lime in plaster coats shall not be less than 1 part lime to 6 parts cement to allow a minimum acceptable vapor permeability. The combined thickness of plaster coats shall not be more than 1 inch (25mm).

ASTM

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C1788-14: Standard Specification for Non Metallic Plaster Bases (Lath) Used with Portland Cement Based Plaster in Vertical Wall Applications

Reason: Even more than wood frame or conventional masonry structures, adobe walls require vapor permeable finishes to ensure appropriate performance and service life; moisture that is trapped within adobe wall assemblies can cause failures due to finish separation, salt attack, coving and freeze-thaw related spalling. Although it is accepted that earthen walls require vapor permeable finishes to adequately manage moisture in the assembly and prevent various structural and finish pathologies, existing code language remains based on legacy language that predates current building science. Notably, while stabilized adobes do not require any exterior finishes, unstabilized adobes are required to be finished with conventional cement stucco, a finishing system that without modification has been shown to be insufficiently permeable. Research has shown that simply increasing the lime proportion in ordinary cement plasters can increase vapor permeability to acceptable levels.

Other comments related to this proposal:

- *Necessity: Unstabilized adobe masonry walls are subject to erosion from precipitation. As most of Section 2109 presumes that adobe masonry is used in structural applications, protective finishes are required to prevent structural failures from erosion, coving, and freeze/thaw related spalling.*
- *It is accepted that earthen building materials require exterior finishes that are vapor permeable in order to facilitate drying from moisture that may enter the wall assembly through roof or finish defects, condensation, plumbing failures, flooding, and capillary action from adjacent construction. In the presence of moisture and in the absence of vapor permeable finishes, earthen wall systems are subject to failure due to loss of integrity of the clay/sand matrix, liquification and/or salt-attack. (ASTM E2392)*

- *Plaster Thickness: The 7/8" minimum thickness requirement is identical to one that has existed successfully in the New Mexico Earthen Building Materials Code. Limits on the maximum thickness of applied plasters are required to ensure that the applied renders are securely bonded to the substrate. The New Mexico Earthen Building Materials Code includes no limit on the thickness of plasters; the 2" maximum proposed here is identical to that currently existing in IRC Appendix S.*
- *Vapor Retarders: Class I and II vapor retarders are prohibited here as they are effectively impermeable, having perm ratings of less than 1.*
- *Minimum Perm Rating: Although in many cases higher permeability would be desirable, for purposes of this proposal a minimum perm rating of 3.5 has been established as it allows the use of a 1:1:6 lime amended cement stucco with an applied siloxane water repellent (3.54 perms at 41 mm of thickness per Straube). 1:1:6 stuccos are applied with the same methods as 1:3 stuccos, at similar cost, and have similar durability. Surface applied siloxane based water repellents are effective at inhibiting water infiltration through plaster skins and desired by industry.*
- *Direct application is required as intermediate substrates may inhibit the beneficial outward movement of moisture, and introduces questions of mechanical attachment that cannot adequately be addressed within the scope of this proposal.*
- *Metallic laths are conventionally used for Portland cement based plasters. Requirements and conditions for their use need to be provided.*
- *ASTM C 1063: "Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster". This is the reference standard used elsewhere in the IBC to describe the material and practice requirements for the installation of metallic lathing.*
- *ASTM C926: This Standard Specification for the Application of Cement Stucco is the accepted reference standard for the materials and practices associated with cement stuccos.*
- *Lime requirement: Complimentary to the minimum vapor permeability requirements, this section requires lime to be added to cement stuccos. The constituents of conventional cement stuccos sometimes vary but are typically 1 part cement to 3 parts sand; based on Straube, this formulation yielded only 0.68 perms. The formulation proposed by this section yields 5.13 perms at 35 mm in thickness, or 3.54 perms at 41 mm of thickness when treated with siloxane, providing adequate (but not optimal) permeability while retaining desirable durability characteristics and application procedures of conventional cement stuccos. In both cases, permeability exceeds 5 perms at a 25mm (conventional applied thickness)*
- *Maximum Thickness: Limits on the thickness of applied plasters are required to ensure that the applied renders are securely bonded to the substrate. the 1 1/2" maximum proposed here is identical to that currently existing in IRC Appendix S, the 1" maximum for cement based plasters is required to achieve permeability of greater than 5 perms.*
- *Vapor Permeability of various finishes (per Straube):*

Sample	t [mm]	Permeance [ng/Pa s m ²]	Permeability [ng/Pa s m]	US Perms
Cement :Sand				
1:3 datum	43.5	39	1.7	0.68
1:3 elastomeric coating	39.5	40	--	0.70
1:3 siloxane	41.0	40	1.7	0.70
Cement:Lime:Sand				
1:1:6 datum	35	295	10.3	5.13
1:1:6 linseed	36	223	8.0	3.89
1:1:6 elastomeric	32.5	244	--	4.25
1:1:6 siloxane	41	203	8.3	3.54
1:1:6 calcium stearate	53.5	81	4.3	1.42
1:1:6 calcium stearate	44	142	6.2	2.47
1:1:6 calcium stearate	53.5	41	2.2	0.71
1:1:6 latex paint	36.5	203	--	3.54
1:1:6 oil paint	40	41	--	0.71
Cement:Lime:Sand				
1:2:9 datum	50.5	295	14.9	5.13
1:2:9 linseed	50.5	259	13.1	4.52
Lime:Sand				
1:3 Datum	33.5	565	18.9	9.85
1:3 Datum	35.5	529	18.8	9.22
1:3 Quicklime	32	459	14.7	8.00

Table 2.3: Results of Vapor Permeance Test Results [Straube, 2000]

Bibliography: 2015 New Mexico Earthen Building Materials Code
2015 *International Residential Code Appendix S - Strawbale Construction*

Adobe Conservation: A Preservation Handbook. Compiled by the Technical Staff of Cornerstones Community Partnership. Sunstone Press (Santa Fe, 2006)

ASTM E2392 / E2392M - 10(2016) Standard Guide for Design of Earthen Wall Building Systems

Building with Earth: Design and Technology of Sustainable Architecture. Gernot Minke, Birkhauser (Bern, 2009)

Earth Construction: A Comprehensive Guide. Hugo Houben and Hubert Guillaud, Practical Action Publishing (Rugby, 2008).

Moisture Properties of Plaster and Stucco for Strawbale Buildings. John Straube. (EBNET, 2019)

Sustainable Building with Earth. Horst Schroeder, Springer International Publishing (Switzerland, 2016)

Cost Impact: The code change proposal will decrease the cost of construction

In most cases, the proposed code language expands the options available to design professionals and contractors for the finishing of adobe wall systems without additional cost impact. The inclusion of earthen plasters in particular cases will decrease the cost of construction for some projects.

Staff Analysis: A review of the standard proposed for inclusion in the code, ASTM C1788-14, with regard to the ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before April 2, 2019.

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Public Hearing Results

Committee Action:

Disapproved

Committee Reason: The committee found the proposal as written to be confusing and possibly more suited for an appendix.

(Vote: 11-3)

Assembly Action:

None

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Individual Consideration Agenda

Public Comment 1:

IBC®: 2109.2.4.8, 2109.2.4.8.1 (New), 2109.2.4.8.2 (New), 2109.2.4.8.3 (New), 2109.2.4.8.4 (New), 2109.2.4.8.5 (New), 2109.2.4.8.6 (New)

Proponents: Ben Loescher, representing The Earthbuilders' Guild (bloescher@lmarchitectsinc.com); David Eisenberg, DCAT, representing DCAT (strawnet@gmail.com); Martin Hammer, representing Martin Hammer, Architect (mfhammer@pacbell.net)
requests As Modified by Public Comment

Modify as follows:

2018 International Building Code

2109.2.4.8 Exterior finish. Exterior finishes applied to adobe masonry walls shall be of any type permitted by this code and shall comply with the provisions of this section and or with Chapter 14, except where stated otherwise in this section.

2109.2.4.8.1 Purpose, and type Where required. Unstabilized adobe masonry walls shall be finished on their exterior with a plaster of any type in this section to provide protection from weather receive a weather protective exterior finish in accordance with this code Section 2109.2.4.8.

2109.2.4.8.2 Vapor retarders and v Vapor permeance. Glass I and II vapor retarders shall not be used on any adobe masonry wall, nor shall any other material be used that has a vapor permeance rating of less than 5 perms. Plaster and finish assemblies shall have a vapor permeance of not less than 5 perms.

Exception: Insulation products applied to the exterior of stabilized adobe masonry walls in Climate Zones 2B, 3B, 4B and 5B shall have no vapor permeance requirement.

2109.2.4.8.3 Plaster thickness and coats. Plaster applied to adobe masonry shall be not less than 7/8" (22 mm) and not greater than 2 inches (51 mm) thick. Plaster shall be applied in not less than two coats.

2109.2.4.8.4 Plaster application. Plaster shall be Where plaster is applied directly to adobe masonry walls, no intermediate membrane shall be used, any type of membrane to facilitate transpiration of moisture from the masonry units, and to secure a mechanical bond between the masonry and plaster.

2109.2.4.8.5 Lath for plaster. Lath shall be provided for all plasters, except ~~as otherwise where not required elsewhere in this section~~ Section 2019.2.4.8. Fasteners shall be corrosion resistant and spaced at a maximum of 16 inches (406mm) on center maximum with a minimum 1-1/2 inches (38 mm) penetration into the adobe wall. Metal lath shall comply with ASTM C1063, as modified by this section, and shall be corrosion resistant. Plastic lath shall comply with ASTM C1788, as modified by this section. Wood substrates shall be protected with #15 asphalt felt, an approved wood preservative or other protective coating prior to lath application.

2109.2.4.8.6 Cement plaster. Cement plaster shall conform to ASTM C926 and shall comply with Chapter 25, except that the proportion of lime in plaster coats shall not be less than 1 part lime to 6.4 parts cement ~~to allow a minimum acceptable vapor permeability.~~ The combined thickness of cement plaster coats shall not ~~be more than~~ exceed 1 inch (25mm).

Commenter's Reason: Proposal S156-19 was the first of a set of four proposals addressing finishes on adobe walls. This set of proposals was intended to address a serious flaw in the existing provisions related to the permeance of finishes on adobe walls, as well as add needed provisions for all finishes, and provide an appropriate place in the section for the addition of the finishes proposed in the following three proposals that were ultimately approved by the Committee.

Three factors resulted S156 being disapproved. Two were the result of confusion that was evident as the Committee heard proposal S156. The third was the result of concerns about wording specific to the proposal, which is addressed by this public comment.

First was the decision to separate these changes into four separate proposals, with the intention of making sure that the paramount concern, the permeance issue was addressed in S156, regardless of the potential outcome for the newly proposed plaster types that were in the other three proposals. Ironically, the outcome was the opposite when S156 was disapproved.

Second was the result of formatting and section numbering changes in the cdpACCESS process that made the four proposals appear as separate and independent from each other, rather than as S156 clearly being the overarching section under which the new sections for lime plasters, lime-cement plasters, and clay plasters proposed and approved in S157, S158, and S159 would exist. For clarity, we have included below, how the entire Adobe finishes section would appear if this public comment is approved, including the sections already approved from proposals S157-19, S158-19, and S159-19.

Third, were the Committee's specific concerns about language that needed improvement, resulting in S156 being disapproved. As the other three proposals were heard, greater clarity emerged about both the importance of addressing the permeance issue and added requirements for finishes, and the need for the structure that S156 provided for the other proposals. The Committee approved the other three proposals as submitted, in part to strengthen the case for approval of a public comment on S156. There were strong recommendations from committee members about the importance of addressing the permeance issue for finishes.

The specific changes made in response to the committee's comments are:

- eliminating ambiguity and removing language that was essentially commentary,
- clarifying language related to plaster thickness, permeance, substrates, the lathing exception, and the protection of wood substrates.
- clarifying language related to plaster thickness, permeance, substrates, the lathing exception, and the protection of wood substrates. An exception was added to allow less permeable insulation products in response to input from industry. Impermeable insulation products applied over asphalt-emulsion stabilized adobe walls have been used successfully for over thirty years in low humidity regions of the western United States. Their continued use is important to achieve energy code compliance until vapor permeable insulation products suitable for use beneath plaster or other finishes become readily available.

Note: In the Committee Reason for their vote to disapprove this proposal, there is mention of these provisions possibly being more suited for an appendix. Mention of an appendix was entirely the result of the mistaken comment of a person testifying in support having said these provisions were in an appendix. When it was pointed out that the Adobe provisions have been in the body of the IBC from the very first version, the person apologized and asked the Committee to disregard that part of his testimony. Nothing in the proposal, nor in other testimony or direct discussion among the Committee recommended moving this section to an appendix.

Background

Like traditional solid masonry walls, adobe masonry walls require vapor permeable finishes to ensure appropriate performance and service life. Moisture that is trapped within adobe wall assemblies behind impermeable finishes can lead to failures such as finish separation, salt attack, coving and freeze-thaw related spalling, and in extreme cases, structural collapse. Although this is widely known, existing language allowing non-permeable cement plasters remains in the code based on legacy language that predates current building science. Notably, while the current code does not require an exterior finish for stabilized adobe walls, it requires that unstabilized adobe walls be finished with conventional cement stucco, a finishing system that, without the modifications in this public comment, is vapor impermeable.

This proposal includes the addition of language for permeable finishes and is informed by code provisions and guidance from the 2015 *New Mexico Earthen Building Materials Code*, ASTM E2392-10 *Standard Guide for Design of Earthen Wall Building Systems*, and IRC Committee approved changes for the 2021 IRC Appendix S - Strawbale Construction.

For overall clarity about how the four proposals (S156-19, S157-19, S158-19, and S159-19) were intended to relate to each other, below is how full Adobe Finishes section would look renumbered, and including the changes proposed in this public comment as well as those from the already approved proposals listed above, which are shown *italicized*:

2109.2.4.8 Exterior finish. Exterior finishes applied to adobe masonry walls shall be of any type permitted by this section or Chapter 14, except where stated otherwise in this section.

2109.2.4.8.1 Where required. Unstabilized adobe masonry walls shall receive a weather protective exterior finish in accordance with Section 2109.2.4.8.

2109.2.4.8.2 Vapor permeance. Plaster and finish assemblies shall have a vapor permeance of not less than 5 perms.

Exception: Insulation products applied to the exterior of stabilized adobe masonry walls in Climate Zones 2B, 3B, 4B and 5B shall have no vapor permeance requirement.

2109.2.4.8.3 Plaster thickness and coats. Plaster applied to adobe masonry shall be not less than 7/8" (22 mm) and not greater than 2 inches (51 mm) thick. Plaster shall be applied in not less than two coats.

2109.2.4.8.4 Plaster application. Where plaster is applied directly to adobe masonry walls, no intermediate membrane shall be used.

2109.2.4.8.5 Lath for plaster. Lath shall be provided for all plasters, except where not required elsewhere in section 2109.2.4.8. Fasteners shall be corrosion resistant and spaced at a maximum of 16 inches (406mm) on center with a minimum 1-1/2 inches (38 mm) penetration into the adobe wall. Metal lath shall comply with ASTM C1063, as modified by this section, and shall be corrosion resistant. Plastic lath shall comply with ASTM C1788, as modified by this section. Wood substrates shall be treated with #15 asphalt felt, an *approved* wood preservative or other protective coating prior to lath application.

2109.2.4.8.6 Cement plaster. Cement plaster shall conform to ASTM C926 and comply with Chapter 25, except that the proportion of lime in plaster coats shall not be less than 1 part lime to 4 parts cement. The combined thickness of cement plaster coats shall not exceed 1 inch (25 mm).

2109.2.4.8.7 Lime Plaster. *Lime plaster is any plaster with a binder composed of calcium hydroxide, including Type N or S hydrated lime, hydraulic lime, natural hydraulic lime, or slaked quicklime. Hydrated lime shall comply with ASTM C206. Hydraulic lime shall comply with ASTM C1707. Natural hydraulic lime shall comply with ASTM C141 and EN 459. Quicklime shall comply with ASTM C5.*

2109.2.4.8.8 Cement-lime plaster. *Cement-lime plaster shall be any plaster mix type CL, F or FL, as described in ASTM C926.*

2109.2.4.8.9 Clay Plaster. *Clay plaster shall comply with this section.*

2109.2.4.8.9.1 General. *Clay plaster shall be any plaster having a clay or clay subsoil binder. Such plaster shall contain sufficient clay to fully bind the aggregate, and shall be permitted to contain reinforcing fibers. Acceptable reinforcing fibers include chopped straw, sisal, and animal hair.*

2109.2.4.8.9.2 Clay subsoil requirements. *The suitability of clay subsoil shall be determined in accordance with the Figure 2 Ribbon Test and the Figure 3 Ball Test in the appendix of ASTM E2392/E2392M.*

2109.2.4.8.9.3 Weather exposed locations. *Clay plaster exposed to water from direct or wind-driven rain, or snow, shall be finished with an approved erosion-resistant finish. The use of clay plasters shall not be permitted on weather exposed parapets.*

2109.2.4.8.9.4 Prohibited finish coat. *Plaster containing Portland cement shall not be permitted as a finish over clay plaster.*

2109.2.4.8.9.5 Conditions where lathing is not required. *For unstabilized adobe walls finished with unstabilized clay plaster, lathing shall not be required.*

Bibliography: 2015 New Mexico Earthen Building Materials Code

Adobe Conservation: A Preservation Handbook. Compiled by the Technical Staff of Cornerstones Community Partnership. Sunstone Press (Santa Fe, 2006)

ASTM E2392 / E2392M - 10(2016) Standard Guide for Design of Earthen Wall Building Systems

Building with Earth: Design and Technology of Sustainable Architecture. Gernot Minke, Birkhauser (Bern, 2009)

Earth Construction: A Comprehensive Guide. Hugo Houben and Hubert Guillaud, Practical Action Publishing (Rugby, 2008).

Moisture Properties of Plaster and Stucco for Strawbale Buildings. John Straube. (EBNET, 2019)

Sustainable Building with Earth. Horst Schroeder, Springer International Publishing (Switzerland, 2016)

Cost Impact: The net effect of the public comment and code change proposal will not increase or decrease the cost of construction. The proposed change has no impact on the cost of construction. In most cases, the proposed code language expands the options available to design professionals and contractors for the finishing of adobe wall systems without additional cost impact.