



TO: DSD Associates

FROM: Michael Shannon, Director and Building Official

DATE: September 17, 2018

FILE: Code Interpretation Manual

INTERPRETATION NUMBER: CI2018-001

TITLE: Use of Earthen Construction in addition to Adobe Masonry

CODE EDITION: 2018 International Building Code (IBC), as amended by COSA

SECTION: 2018 IBC Section 2109, Chapter 10 Section 10-5 (n)

QUESTION 1: Does the City permit the use of Earthen Construction under the 2018 IBC?

ANSWER: Yes. Chapter 10 Section 10-5 (n) allows the Building Official to approve an alternative method of construction if the proposed design is satisfactory and complies with the intent of code. Amendments to IBC Section 2109 were reviewed and recommended for adoption by the Building-related and Fire Codes Appeals and Advisory Board. The City had intended to include the recommended amendments to IBC Section 2109 in Chapter 10 of the City's Code of Ordinances that includes all of the amendments for the Building-Related Codes. Since the information was unintentionally left out of the adopted ordinance, the Development Services Department created this Code Interpretation to incorporate the design guidelines for Earthen Construction.

SECTION 2109
EMPIRICAL DESIGN OF [ADOBE MASONRY] EARTHEN WALL SYSTEMS

2109.1 General. Empirically designed [~~adobe masonry~~] earthen wall systems shall conform to the requirements of Appendix A of TMS 402, except where otherwise noted in this section.

2109.1.1 Limitations. The use of empirical design of earthen wall systems [~~adobe masonry~~] shall be limited as noted below [~~in Section A.1.2 of TMS 402~~]. In buildings that exceed one or more of the limitations below [~~of Section A.1.2 of TMS 402~~], [~~masonry~~] earthen wall systems shall be designed in accordance with the engineered design provisions of Section 2101.2 [~~or the foundation wall provisions of Section 1807.1-5~~].

[Section A.1.2.2 of TMS 402 shall be modified as follows:

A.1.2.2 Wind. Empirical requirements shall not apply to the design or construction of masonry for buildings, parts of buildings, or other structures to be located in areas where

~~V_{add} as determined in accordance with Section 1609.3.1 of the *International Building Code* exceeds 110 mph.]~~

2109.1.1.1 Gravity Loads. The resultant of gravity loads shall be placed within the center third of the wall thickness and within the central area bounded by lines at one-third of each cross-sectional dimension of foundation piers.

2109.1.1.2 Seismic. Empirically designed earthen wall systems are not permitted for buildings, parts of buildings or other structures in Seismic Design Categories B,C,D,E or F as defined in ASCE 7.

2109.1.1.3 Wind. Empirically designed earthen wall systems are not permitted for buildings, parts of buildings or other structures where the basic wind speed exceeds 115 mph (51 mps).

2109.1.1.4 Risk category. Empirically designed earthen wall systems are not permitted for buildings, parts of buildings or other structures in Risk Category IV as defined in ASCE 7.

2109.1.1.5 Other horizontal loads. Empirical requirements shall not apply to earthen wall systems resisting horizontal loads other than permitted wind or seismic loads.

2109.1.1.6 Support. Empirical requirements shall not apply to earthen wall systems vertically supported on wood construction.

2109.1.1.7 Below grade. Earthen construction shall not be permitted for use in foundations, footings, retaining walls or in any building element at or below grade.

2109.1.1.8 Height and area. Empirically designed earthen construction shall be limited to buildings or parts of buildings with a braced wall height not exceeding 9 feet (2.74 m) and an enclosed area less than or equal to 1600 square feet (150 m²).

Exception: For buildings of empirically designed earthen construction when designed by a registered design professional, wall height limitation shall be increased to a maximum of 35 feet (10.6 m) as measured from the average specified finish grade adjacent to the wall and area limitations shall not apply.

2109.2 [Adobe] Earthen construction. ~~[Adobe] Earthen construction shall comply with this section and shall be subject to the requirements of this code for Type V construction, Appendix A of TMS 402 and this section.~~

2109.2.1 Unstabilized [adobe] earthen construction. ~~Unstabilized [adobe] earthen construction shall comply with Sections 2109.2.1.1 through 2109.2.1.5[4].~~

2109.2.1.1 Characteristic [C]compressive strength, f_c . ~~[Adobe] Earthen construction units shall have an average characteristic compressive strength as required by design but not less than 150 psi (1034 kPa). [of 300 psi (2068 kPa) when tested in accordance with ASTM C67.] Five samples shall be tested in accordance with ASTM C67 and characteristic compressive strength for each unit shall be determined by multiplying the result by the correction multiplier provided in Table 2109.2.1.1. [and individual unit are not] No individual unit is permitted to have a characteristic compressive strength of less than 125 psi (862 kPa). [250 psi (1724) kPa].~~

TABLE 2109.2.1.1

PRISM STRENGTH CORRECTION FOR CHARACTERISTIC COMPRESSIVE STRENGTH, f_c

| Test Unit Height to Least Width Ratio H/W | ASTM C67 Correction Multiplier |
|---|--------------------------------|
| <=0.5 | 0.50 |
| 0.70 | 0.60 |
| 1 | 0.70 |
| 1.5 | 0.75 |
| 2 | 0.77 |
| 3 | 0.95 |
| 4 | 1.00 |

2109.2.1.2 Modulus of rupture. [~~Adobe~~] Earthen construction units shall have an average modulus of rupture of not less than 50 psi (345 kPa) when tested in accordance with the following procedure. Five samples shall be tested and individual units shall not have a modulus of rupture of less than 35 psi (241 kPa).

[2109.2.1.3 Moisture content requirements. ~~Adobe units shall have a moisture content not exceeding 4 percent by weight.]~~

[2109.2.1.4 Shrinkage cracks. ~~Adobe units shall not contain more than three shrinkage cracks and any single shrinkage crack shall not exceed 3 inches (76 mm) in length or 1/8 inch (3.2 mm) in width.]~~

2109.2.1.3 Condition of units. Adobe masonry and compressed earth block units used in load-bearing construction shall be whole and sound and not more than 10% of the bearing surface shall be missing or chipped. The basic unit competence of any questionable units shall be assessed by the ability to be dropped to a hard level surface from a height of not less than 24 in (609 mm) without fracture or delamination.

2109.2.1.4 Organic matter. Organic matter present in soils used for earthen construction shall be limited to not more than 5% as measured by AASHTO T267 Loss-on-Ignition Test.

Exception: Limits on organic matter content shall not apply to adobe masonry units.

2109.2.1.5 Soil acidity (pH). Prior to use in earthen construction, native soil acidity shall not be less than pH 7.0 as measured by ASTM D4972. Soil pH less than 7.0 shall be treated by thorough mixing with lime to raise pH to an acceptable level prior to use.

2109.2.2 Stabilized [~~adobe~~] earthen construction. Stabilized earthen construction [~~adobe~~] shall additionally comply with [Section 2109.2.1 for unstabilized adobe in addition to] Section[s] 2109.2.2.1 [and 2109.2.2.2].

2109.2.2.1 Soil requirements. Soil used for stabilized earthen construction [~~adobe units~~] shall be volumetrically stable and chemically compatible with the stabilizing material.

[2109.2.2.2 Absorption requirements. ~~A 4-inch (102 mm) cube, cut from a stabilized adobe unit dried to a constant weight in a ventilated oven at 212°F to 239°F (100°C to 115°C), shall not absorb more than 2½ percent moisture by weight when placed on a constantly water-saturated, porous surface for seven days. Not fewer than five specimens shall be tested and each specimen shall be cut from a separate unit.]~~

2109.2.3 Allowable stress. For empirically designed earthen construction, ~~[F]~~the allowable compressive stress on gross cross-sectional area of a unit or sample ~~[adobe]~~ shall not exceed 30 psi (207 kPa).

Table 2109.2.3.1, ALLOWABLE SHEAR ON BOLTS IN ADOBE MASONRY, is amended to reflect changes to the title. Unaltered sections of the Table remain in full force:

**TABLE 2109.2.3.1
ALLOWABLE SHEAR ON BOLTS IN ~~[ADOBE]~~ EARTHEN CONSTRUCTION MASONRY**

2109.2.4 Detailed requirements. ~~[Adobe]~~ Earthen construction shall comply with Sections 2109.2.4.2~~[1]~~ through 2109.2.4.9.

~~[2109.2.4.1 Number of stories. Adobe construction shall be limited to buildings not exceeding one story, except that two-story construction is allowed where designed by a registered design professional.]~~

2109.2.4.2 Mortar. Mortar for adobe masonry and compressed earth blocks ~~[construction]~~ shall comply with Sections 2109.2.4.2.1 and 2109.2.4.2.2.

2109.2.4.2.1 General. Mortar for use in earthen construction ~~[adobe units]~~ shall be ~~[in accordance with Section 2103.2.1, or be]~~ composed of ~~[adobe]~~ soil of ~~[the same]~~ like composition and stabilization as the ~~[adobe brick]~~ earthen construction units. ~~[Unstabilized adobe soil mortar is permitted in conjunction with unstabilized adobe brick units.]~~

2109.2.4.2.2 Mortar joints. Adobe masonry and compressed earth block units shall be laid with full head and bed joints and in full running bond of minimum ¼ unit overlap.

2109.2.4.3 Parapet walls. Parapet walls shall be constructed of stabilized earthen construction materials only. Parapet walls shall include flashing as described in Section 1404.4. ~~[constructed of adobe units shall be waterproofed.]~~

2109.2.4.4 Wall thickness. For empirically designed earthen construction, ~~[F]~~the minimum thickness of exterior walls in one-story buildings shall be 10 inches (254 mm). The walls shall be laterally supported at intervals not exceeding 24 feet (7315 mm). The minimum thickness of interior load-bearing walls shall be 8 inches (203 mm). The unsupported height of any wall of earthen construction ~~[constructed of adobe units]~~ shall not exceed 10 times the thickness of such wall.

2109.2.4.5 Foundations. Foundations for earthen ~~[adobe]~~ construction shall be in accordance with Section 2109.2.4.5.1 through ~~[and]~~ 2109.2.4.5.~~[2]~~5.

2109.2.4.5.1 Foundation support. Load-bearing and nonload-bearing [W]walls [and partitions] constructed of ~~[adobe units]~~ earthen construction shall be supported by continuous footings and foundations. Width of foundation walls shall not be less than the width of earthen construction walls which they support. ~~[foundations or footings that extend not less than 6 inches (152 mm) above adjacent ground surfaces and are constructed of solid masonry (excluding adobe) or concrete. Footings and foundations shall comply with Chapter 18.]~~

2109.2.4.5.2 Lower course requirements. ~~[Stabilized adobe units shall be used in adobe walls for the first 4 inches (102 mm) above the finished first-floor elevation.]~~ The lowest course of any wall of unstabilized adobe masonry units shall be stabilized.

2109.2.4.5.3 Height above grade. Foundation walls for earthen construction shall extend not less than 6 inches (152 mm) above adjacent finish grade.

2109.2.4.5.4 Damp-proofing. The lowest course of earthen construction shall be protected with a continuous damp-proofing barrier applied directly to the full width of the bearing surface of foundation walls. Maximum permeance of damp-proofing barrier shall be IBC Class I or II with a perm moisture rating of not more than 0.5 perm.

Exception: Damp-proofing may be held back a maximum of $\frac{3}{4}$ inches (20mm) at interior surfaces of walls not exposed to weather.

2109.2.4.5.5 Site Drainage. Grade surfaces adjacent to earthen wall systems shall be designed to provide adequate flow of water away from the foundation.

2109.2.4.6 Isolated piers or columns. [~~Adobe units~~] Earthen construction shall not be used for isolated piers or columns in a load-bearing capacity. Walls with a length less than the greater of three (3) times the wall thickness or [~~less than~~] 24 inches (610 mm) [~~in length~~] shall be considered to be isolated piers or columns.

2109.2.4.7 Tie beams. Exterior walls and interior load-bearing walls constructed of [~~adobe units~~] earthen construction shall have a continuous tie beam at the level of the floor or roof bearing and meeting the following requirements.

2109.2.4.8 Exterior finish. Exterior walls constructed of unstabilized [~~adobe units~~] earthen construction shall have their exterior surface covered with no[t] fewer than two coats of vapor-permeable mineral based [~~Portland cement~~] plaster having a minimum thickness of $\frac{3}{4}$ inch (19.1 mm) and conforming to ASTM C926. Where lathing is used as the method of plaster attachment, lathing shall be of galvanized stucco netting anchored [~~Lathing shall comply with ASTM C106. Fasteners shall be spaced~~] at 16 inches (406 mm) on center maximum with galvanized fasteners. Exposed wood surfaces shall be treated with an approved wood preservative or other protective coating prior to lath application.



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