

Low Carbon Construction Voting Guide

ICC 2022 Online Governmental Consensus Voting

Group B Code Development Cycle

October 10-24, 2022

www.cdpassess.com

This week, building officials will begin voting on proposed changes to the International Building Code (IBC) and International Residential Code (IRC), including on four proposals authored by The Earthbuilders' Guild (TEG), The Cob Research Institute (CRI) and The California Straw Building Association (CASBA), and the Development Center for Appropriate Technology (DCAT). These organizations urge eligible voters to affirm these proposals which reduce barriers to appropriate low-carbon construction.

The tables below include brief descriptions of the four proposals and summaries of the reason statements from our Public Comments as well as the results of the voting at the Public Comment Hearings in Louisville in September. They also include links to the videos of the testimony for each public comment. We have also attached the full public comments with our annotations clarifying ICC's slightly confusing format that first shows the original code change proposal, followed by the public comment.

This online vote is the final step in ICC's code development process for the 2024 IBC and IRC. All four proposals were approved overwhelmingly (by more than 93%) at the Public Comment hearings last month.

Eligible ICC members can vote via cdpassess from October 10th through October 24th. We also encourage those who are not eligible voters to advocate for these proposals with building officials who support expansion of low-carbon construction.

For any questions about these proposals, please contact:

Anthony Dente, PE
Verdant Structural Engineers
anthony@verdantstructural.com

David Eisenberg
The Development Center for Appropriate Technology
strawnet@gmail.com

Ben Loescher, AIA
Loescher Meachem Architects,
bloescher@lma.la

These proposals are endorsed by the following organizations:

- The California Straw Building Association (CASBA) strawbuilding.org
- The Cob Research Institute cobcode.org
- The Development Center for Appropriate Technology dcat.net
- The Earthbuilders' Guild theearthbuildersguild.com

International Building Code - Structural

IBC Proposal #	Proposal / Comment Description	Public Comment Recommended Vote and Action	Public Comment Hearing Voting Results	PCH Video	Reason Statement Summary
S144	The original proposal deleted all adobe provisions within the IBC due to an issue with a retired reference. This public comment reinstates the reference to TMS 402-16 Appendix A, and retains adobe brick code provisions within the code.	Support AMPC 1 (As Modified by Public Comment 1)	Approved 118 to 5 95.93% (requires 2/3 vote in support for approval because it reverses the CAH disapproval)	Video Link	These code sections contain language critical to guiding the design and use of adobe masonry, and corrects the inadvertent impacts of the proposed deletions of these sections as part of a standards update by another proponent. This proposal represents language acceptable both to the original proponent and the adobe industry.
S185	This public comment corrects a long-standing typographical error. A previous proposal was disapproved solely due to CAH action on S144 proposed for reversal in PCH.	Support AS	Approved 112 to 8 93.33% (requires a simple majority)	Video Link	This proposal corrects a long-standing typographical error which may erroneously lead a reader to conclude that the seismic limitations included in TMS 402-16 Appendix A do not apply to adobe construction.

International Residential Code

IRC Proposal #	Proposal / Comment Description	Public Comment Recommended Vote and Action	Public Comment Hearing Voting Results	PCH Video	Reason Statement Summary
RB166	This proposal extends the use of crushed stone footings currently allowable for wood and precast concrete foundations to include concrete foundations, with the same conditions and requirements. PC1 resolves concerns raised in the CAH.	Support AMPC 1	Approved 76 to 4 95% (requires 2/3 vote in support for approval because it reverses the CAH disapproval)	Video Link	This public comment addresses all the issues raised in testimony and by the Committee at the CAH, to extend the already allowed use of crushed footings to include cast-in-place foundation walls and slabs with turned down foundations, with appropriate additional limitations including for townhouses to seismic zones A and B, for non-retaining use only, maximum spacing of perpendicular braced wall lines. Additionally, the provisions are now entirely prescriptive, and there are new or revised figures reflecting the changes to the proposed text. The representatives for FEMA and others who testified in opposition at the CAH testified in support at the Public Comment hearing.
RB310	This proposal recognizes a 2 hour fire rating for specified cob walls based on the results of ASTM E119 testing. PC1 resolves concerns raised in the CAH.	Support AMPC 1	Approved 79 to 2 97.53% (requires 2/3 vote in support for approval because it reverses the CAH disapproval)	Video Link	This public comment addressed all the issues raised at the CAH in both opposition testimony and discussion on the Committee, clarifying that ICC does not require more testing in addition to the two successful ASTM E119 2-hour tests with hose stream tests for the rated assemblies described in the original proposal, that the tested walls easily passed those tests, that those tests were designed in consultation with some of the fire engineering experts who had originally objected to inclusion of a one-hour rating in the original proposal that resulted in disapproval at the CAH, and when deleted by public comment resulted in the approval of the appendix at the PCH for the 2021 IRC. Several of those who spoke in opposition at the CAH spoke in support at the Public Comment Hearing and there was no opposition testimony beyond a question about whether the tests included hose stream tests, which they did.

S144-22

IBC: 1705.4, SECTION 2109

Proposed Change as Submitted

Proponents: Jason Thompson, representing Masonry Alliance for Codes and Standards (jthompson@ncma.org)

The primary section number and title shown as deleted (2109) includes the deletion of all sections and subsections within it. For clarity, the full text of these deletions is not shown.

2021 International Building Code

Revise as follows:

1705.4 Masonry construction. *Special inspections* and tests of masonry construction shall be performed in accordance with the quality assurance program requirements of TMS 402 and TMS 602.

Exception: *Special inspections* and tests shall not be required for:

1. ~~Glass unit masonry or masonry veneer designed in accordance with Section 2110 or Chapter 14. Empirically designed masonry, glass unit masonry or masonry veneer designed in accordance with Section 2109, Section 2110 or Chapter 14, respectively, where they are part of a structure classified as Risk Category I, II or III.~~
2. Masonry foundation walls constructed in accordance with Table 1807.1.6.3(1), 1807.1.6.3(2), 1807.1.6.3(3) or 1807.1.6.3(4).
3. Masonry fireplaces, masonry heaters or masonry chimneys installed or constructed in accordance with Section 2111, 2112 or 2113, respectively.

Delete without substitution:

SECTION 2109 EMPIRICAL DESIGN OF ADOBE MASONRY

Reason: The option for empirically designed masonry has been removed from the 2022 edition of TMS 402. As such, references to these provisions from the IBC are also being deleted - including all of Section 2109 of the IBC. Of note, the scope of Section 2109 is limited to empirically designed adobe masonry construction. Although there is a reference to the empirical design provisions of TMS 402 in Section 2109, there are questions as to whether the use of the empirical design provisions of TMS 402, which were developed for clay and concrete masonry construction, are appropriate and applicable to adobe masonry construction.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This code change proposal simply deletes a historical design method that is no longer included in the referenced standard.

S144-22

Public Hearing Results

This proposal includes published errata

<https://cdn-www-v2.iccsafe.org/wp-content/uploads/2022-GROUP-B-CONSOLIDATED-MONOGRAPH-UPDATES-3-14-22.pdf>

Committee Action:

As Submitted

Committee Reason: Approved as submitted as the proposal deletes a design method that is no longer in the referenced standard. (Vote: 14-0)

S144-22

Individual Consideration Agenda

Public Comment 1:

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

Replace as follows:

2021 International Building Code

1705.4 Masonry construction. *Special inspections* and tests of masonry construction shall be performed in accordance with the quality assurance program requirements of TMS 402 and TMS 602.

Exception: *Special inspections* and tests shall not be required for:

1. ~~Glass unit masonry or masonry veneer designed in accordance with Section 2110 or Chapter 14. Empirically designed masonry, glass unit masonry or masonry veneer designed in accordance with Section 2109, Section 2110 or Chapter 14, respectively, where they are~~ part of a structure classified as Risk Category I, II or III.
2. Masonry foundation walls constructed in accordance with Table 1807.1.6.3(1), 1807.1.6.3(2), 1807.1.6.3(3) or 1807.1.6.3(4).
3. Masonry fireplaces, masonry heaters or masonry chimneys installed or constructed in accordance with Section 2111, 2112 or 2113, respectively.

SECTION 2109 EMPIRICAL DESIGN OF ADOBE MASONRY

2109.1 General. Empirically designed adobe masonry shall conform to the requirements of Appendix A of TMS 402-16, except where otherwise noted in this section.

2109.1.1 Limitations. The use of empirical design of adobe masonry shall be limited as noted in Section A.1.2 of TMS 402-16. In buildings that exceed one or more of the limitations of Section A.1.2 of TMS 402-16, masonry 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 402-16 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_{asd} as determined in accordance with Section 1609.3.1 of the *International Building Code* exceeds 110 mph.

2109.2 Adobe construction. *Adobe construction* shall comply with this section and shall be subject to the requirements of this code for Type V construction, Appendix A of TMS 402-16, and this section.

Commenter's Reason: Summary:

The intent of proposal S144-22, approved in the Committee Action Hearings was to remove the reference in the IBC, to the soon-to-be-retired Appendix A of TMS 402. However this action has the consequence of deleting all language in the IBC pertaining to adobe construction, which will be devastating to a relatively small but significant regional industry for both contemporary and historical adobe structures. This includes material suppliers, design and building professionals and owners and occupants of adobe masonry structures. This Public Comment achieves the goals of the original proposal's authors while preserving the critical provisions of Section 2109 Empirical Design of Adobe Masonry, to regulate the structural design and material requirements of adobe masonry, which would otherwise become unregulated.

Empirical Design:

The adobe section of the IBC has successfully relied upon the empirical design provisions of TMS 402 without controversy since the IBC's first edition in the year 2000. In recent years TMS 402's authors have decided to no longer use empirical design for contemporary masonry materials, construction methods and building types, because these modern buildings and materials no longer rely on the smaller quantity and size of openings, more frequent cross walls, and shorter walls assumed in Appendix A. These points do not apply to adobe construction whose utilization consists of small, one- or two-story buildings with small openings, cross walls, and conservative height/thickness ratios.

Additionally, adobe is a material for which there is greater variability in mortar and masonry unit qualities than modern masonry products. As a result, cost-effective adobe construction depends upon time-tested and appropriately conservative empirical methods to guide design for the smaller scale projects it is used for, that cannot justify the expense of laboratory testing for each source and product.

TMS 402 Appendix A:

While Appendix A will no longer be included in future editions of TMS 402, retaining reference to the current edition (TMS 402- 16) will allow adobe to remain in the IBC until a standard specific to adobe construction can be created and approved as a referenced standard in the IBC. The proponents of this Public Comment have conferred with The Masonry Society (the propagator of TMS 402), who have confirmed that TMS 402-16 will remain available for the foreseeable future.

Windspeed:

A related Public Comment on Proposal S185-22 proposes to correct a typographical error in 2109.1.1.

Cost Impact: The net effect of the public comment and code change proposal will decrease the cost of construction. By avoiding the deletion of code provisions for adobe construction, this Public Comment will provide contractors and consumers the ability to use a building material which is cost-effective in the regions that it is used, and particularly beneficial to owner-builders and projects in rural areas.

Cost Impact: The net effect of the public comment and code change proposal will decrease the cost of construction. By avoiding the deletion of code provisions for adobe construction, this Public Comment will provide contractors and consumers the ability to use a building material which is cost-effective in the regions that it is used, and particularly beneficial to owner-builders and projects in rural areas.

Public Comment# 3181

Public Comment 2 was withdrawn because TMS402-22 was published at the time of the hearings.

Public Comment 2:

Proponents: CP28 administration

Commenter's Reason: The administration of ICC Council Policy 28 (CP28) is not taking a position on this code change. This public comment is being submitted to bring a procedural requirement to the attention of the ICC voting membership. In accordance with Section 3.6.3.1.1 of ICC Council Policy 28 (partially reproduced below), the new referenced standard TMS 402-22 must be completed and readily available prior to the Public Comment Hearing in order for this public comment to be considered.

(CP28) 3.6.3.1.1 Proposed New Standards. In order for a new standard to be considered for reference by the Code, such standard shall be submitted in at least a consensus draft form in accordance with Section 3.4. If the proposed new standard is not submitted in at least consensus draft form, the code change proposal shall be considered incomplete and shall not be processed. The code change proposal shall be considered at the Committee Action Hearing by the applicable code development committee responsible for the corresponding proposed changes to the code text. If the committee action at the Committee Action Hearing is either As Submitted or As Modified and the standard is not completed, the code change proposal shall automatically be placed on the Public Comment Agenda with the recommendation stating that in order for the public comment to be considered, the new standard shall be completed and readily available prior to the Public Comment Hearing.

Cost Impact: The net effect of the public comment and code change proposal will not increase or decrease the cost of construction
N/A

Public Comment# 3536

S185-22

IBC: 2109.1.1

Proposed Change as Submitted

Proponents: John-Jozef Proczka, representing Self (john-jozef.proczka@phoenix.gov)

2021 International Building Code

Revise as follows:

2109.1.1 Limitations. The use of empirical design of adobe masonry shall be limited as noted in Section A.1.2 of TMS 402. In buildings that exceed one or more of the limitations of Section A.1.2 of TMS 402, masonry 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~~ A.1.2.3 of TMS 402 shall be modified as follows:

- ~~A.1.2.2~~ A.1.2.3 – *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_{asd} as determined in accordance with Section 1609.3.1 of the *International Building Code* exceeds 110 mph.

Reason: This code change proposal corrects what appears to be a longstanding typographical error. As the code currently stands the seismic section of TMS 402 Appendix A is eliminated and states wind limitations twice in A1.2.2 and A1.2.3.

There are those who assume this is not a typographical error, but an attempt to completely undo the TMS 402 seismic requirements of Appendix A in the IBC. This is not the case. TMS 402 is specific about what SDCs are allowed and in what capacities.

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

Depending on one's current interpretation of the typographical error this will either have no impact or will restrict adobe masonry to only certain situations in certain SDCs.

S185-22

Public Hearing Results

Committee Action:

Disapproved

Committee Reason: Disapproved as the proposal is no longer needed as adobe has been removed from TMS 402. (Vote: 13-0)

S185-22

Individual Consideration Agenda

Public Comment 1:

IBC: 2109.1.1

Proponents: Ben Loescher, representing The Earthbuilders' Guild (bloescher@lmarchitectsinc.com); Martin Hammer, representing Martin Hammer, Architect (mfhammer@pacbell.net); David Eisenberg, representing DCAT (strawnet@gmail.com); Anthony Dente, representing Verdant Structural Engineers (anthony@verdantstructural.com) requests As Submitted

Commenter's Reason: This Proposal was not approved in the Committee Action Hearings after Proposal S144-22 was approved. Reconsideration is necessitated by Public Comment related to that item.

The current language of Section 2109.1.1 includes what appears to be a longstanding typographical error which incorrectly indicates A1.2.2 for provisions related to Wind; the correct citation for Wind in TMS 402 Appendix A is A1.2.3; A1.2.2 is the reference for Seismic. Without this correction, the reader may incorrectly conclude that Empirical Design of Adobe Masonry is permitted in highly seismic areas (Seismic Design D, E & F) where that design approach is inappropriate.

Cost Impact: The net effect of the public comment and code change proposal will increase the cost of construction

The this code change will clarify the restriction on the use of empirically designed adobe masonry to specific lower seismic risk areas, and as a

result may increase the cost of construction.

Public Comment# 3169

Proposed Change as Submitted

Proponents: Anthony Dente, representing Verdant Structural Engineers (anthony@verdantstructural.com); Martin Hammer, representing Martin Hammer, Architect (mfhammer@pacbell.net); David Eisenberg, representing DCAT (strawnet@gmail.com)

2021 International Residential Code

Revise as follows:

R403.1.1 Minimum size. The minimum width, W, and thickness, T, for concrete footings shall be in accordance with Tables R403.1(1) through R403.1(3) and Figure R403.1(1) or R403.1.3, as applicable, but not less than 12 inches (305 mm) in width and 6 inches (152 mm) in depth. The footing width shall be based on the load-bearing value of the soil in accordance with Table R401.4.1. Footing projections, P, shall be not less than 2 inches (51 mm) and shall not exceed the thickness of the footing. Footing thickness and projection for fireplaces shall be in accordance with Section R1001.2. The size of footings supporting piers and columns shall be based on the tributary load and allowable soil pressure in accordance with Table R401.4.1. Footings for wood foundations shall be in accordance with the details set forth in Section R403.2, and Figures R403.1(2) and R403.1(3). Footings for precast foundations shall be in accordance with the details set forth in Section R403.4, Table R403.4, and Figures R403.4(1) and R403.4(2). Crushed stone footings for masonry or cast-in-place concrete foundations shall be in accordance with Section R403.5.

Add new text as follows:

R403.5 Crushed stone footings for cast-in-place foundations. Crushed stone footings for masonry or cast-in-place concrete foundations complying with Section R404.1 shall comply with Section R403.4.1 except they shall be installed in accordance with Figures R403.5(1) or R403.5(2).

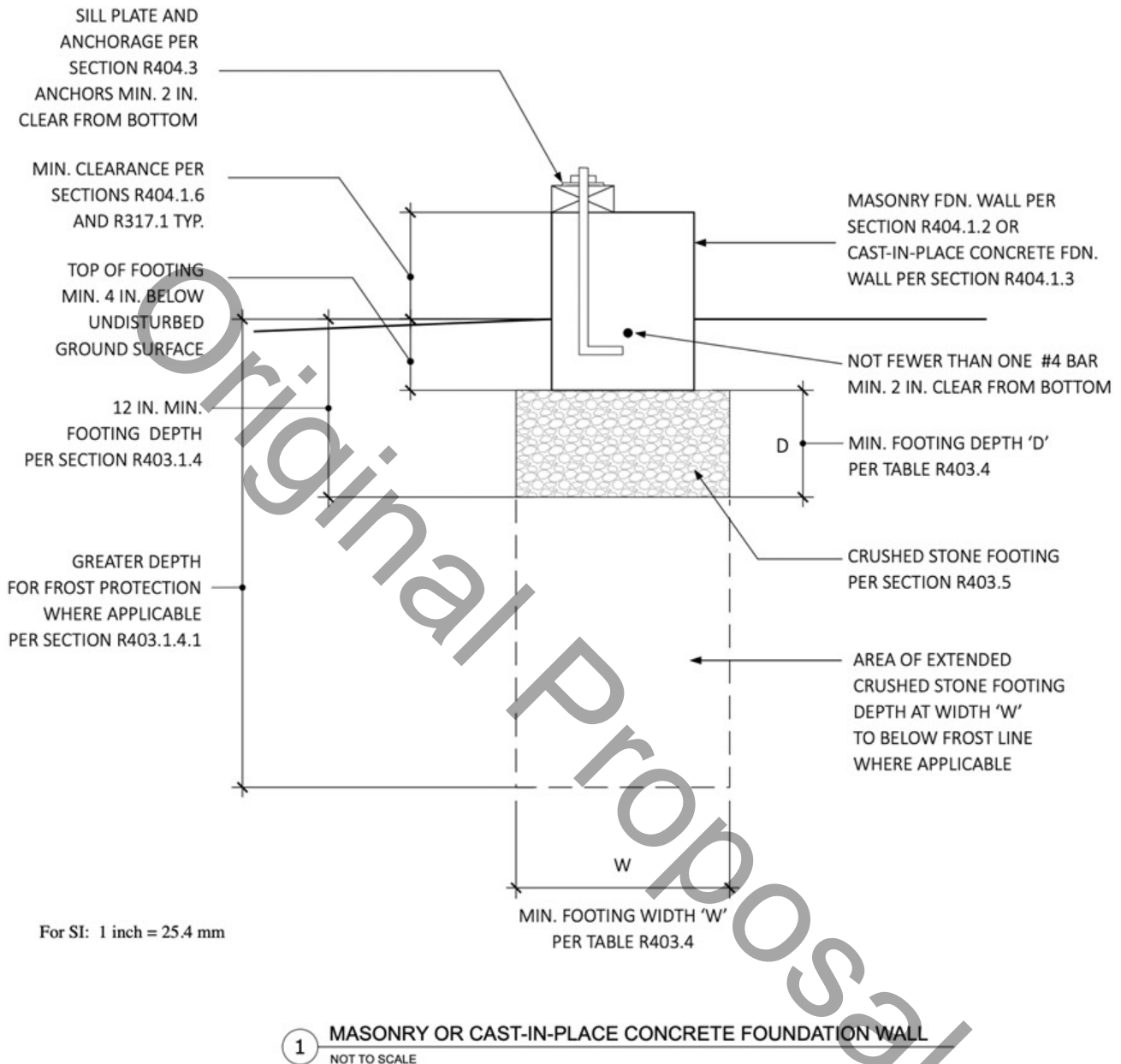
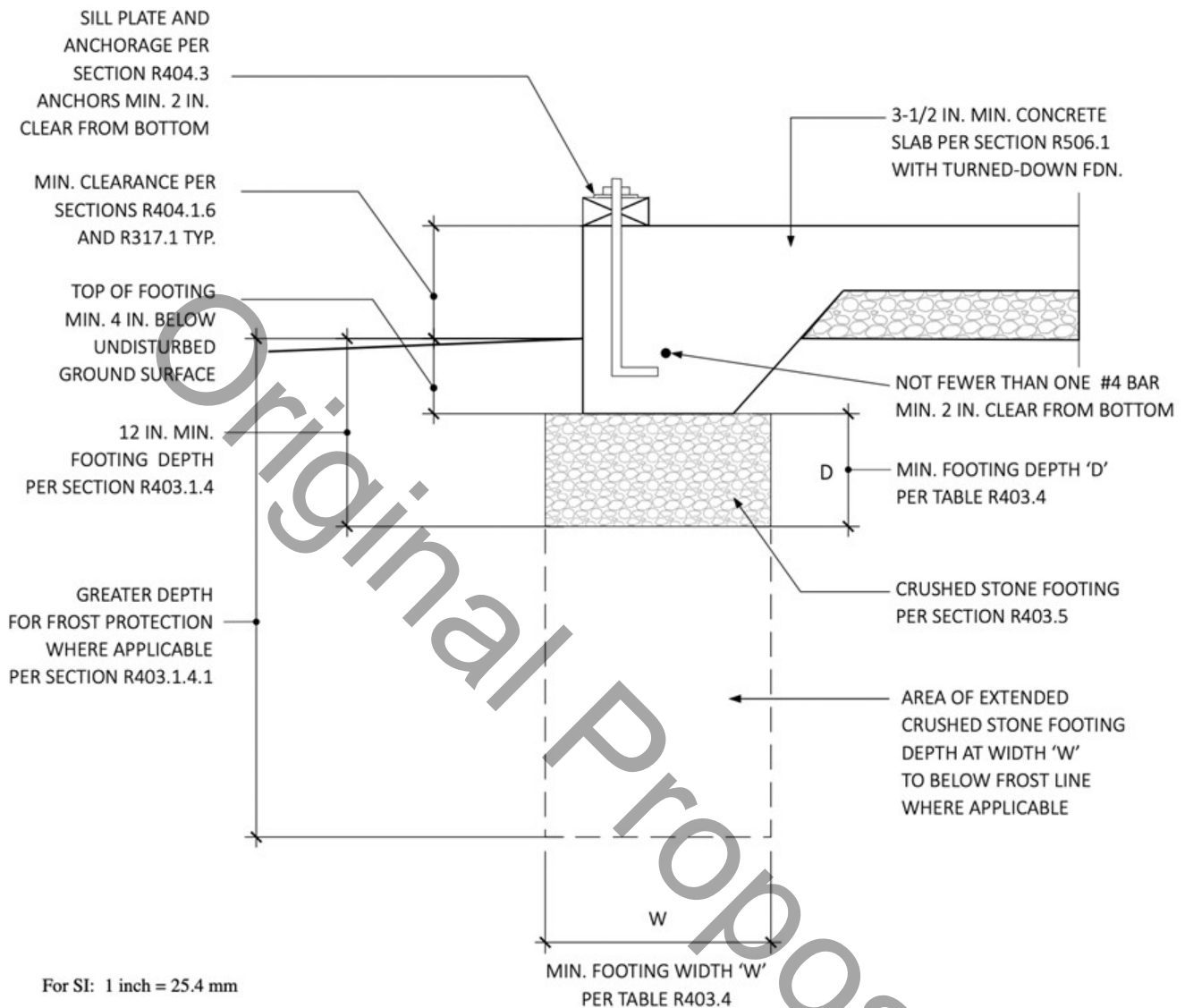


FIGURE R403.5
CRUSHED STONE FOOTINGS
FOR CAST-IN-PLACE FOUNDATIONS
IN SEISMIC DESIGN CATEGORIES A, B, AND C

FIGURE R403.5(1) CRUSHED STONE FOOTINGS FOR CAST-IN-PLACE FOUNDATIONS IN SEISMIC DESIGN CATEGORIES A, B, AND C - MASONRY OR CAST-IN-PLACE CONCRETE FOUNDATION WALL



2 CONCRETE SLAB-ON-GROUND WITH TURNED-DOWN FOUNDATION
NOT TO SCALE

FIGURE R403.5
CRUSHED STONE FOOTINGS
FOR CAST-IN-PLACE FOUNDATIONS
IN SEISMIC DESIGN CATEGORIES A, B, AND C

FIGURE R403.5(2) CRUSHED STONE FOOTINGS FOR CAST-IN-PLACE FOUNDATIONS IN SEISMIC DESIGN CATEGORIES A, B, AND C - CONCRETE SLAB-ON-GROUND WITH TURNED DOWN FOUNDATION

Reason: Crushed stone footings for wood foundations and precast concrete foundations are currently permitted in IRC Sections R403.2 and R403.4.1 respectively. There is also the well-established geotechnical practice of using crushed stone underlayment for foundations of all types. This proposal simply allows these provisions to also be used for masonry foundations and cast-in-place concrete foundations.

This proposal uses identical requirements for crushed stone and its placement as those for analogous pre-cast concrete foundations in Section R403.4.1 (by reference), and for footing width and depth in the associated Table R403.4. The proposal limits the proposed use of crushed stone to Seismic Design Categories A, B, and C, by reference as stated in Section R403.4.1. New Figures R403.5(1) and (2) illustrate the requirements, including minimums regarding the top of the footing relative to undisturbed ground surface. The Figures illustrate two conditions for crushed stone footings: 1) masonry or concrete wall foundation, and 2) slab-on-ground with turned down foundation. Conservatively, not less than one #4 bar is required for these foundations over a crushed stone footing. This is not currently required for plain concrete footings or turned-down footings in Seismic Design Categories A, B, and C. Minimum clearances for the #4 bar and the sill plate anchor are also stated in the Figures.

Cost Impact: The code change proposal will decrease the cost of construction. This proposal adds a less material-intensive, less labor-intensive and therefore less expensive foundation option, by allowing the use of crushed stone instead of concrete for footings in some situations.

RB166-22

Public Hearing Results

Committee Action:

Disapproved

Committee Reason: The proposal addresses requirements for crushed stone footings for masonry or cast-in-place concrete foundations. The committee determined that the proposal requires an engineering design while the IRC includes prescriptive provisions. Therefore, the committee suggested that the proponent look into prescriptive provisions and cooperate with FEMA. The committee was also concerned about potential issues with drainage and stabilization (10-0).

RB166-22

Individual Consideration Agenda

Public Comment 1:

IRC: R403.1.1, R403.5, TABLE R403.5 (New), FIGURE R403.5(1), FIGURE R403.5(2), R403.5(3) (New)

Proponents: Anthony Dente, representing Verdant Structural Engineers (anthony@verdantstructural.com); David Eisenberg, representing DCAT (strawnet@gmail.com); Martin Hammer, representing Martin Hammer, Architect (mfhammer@pacbell.net) requests As Modified by Public Comment

Modify as follows:

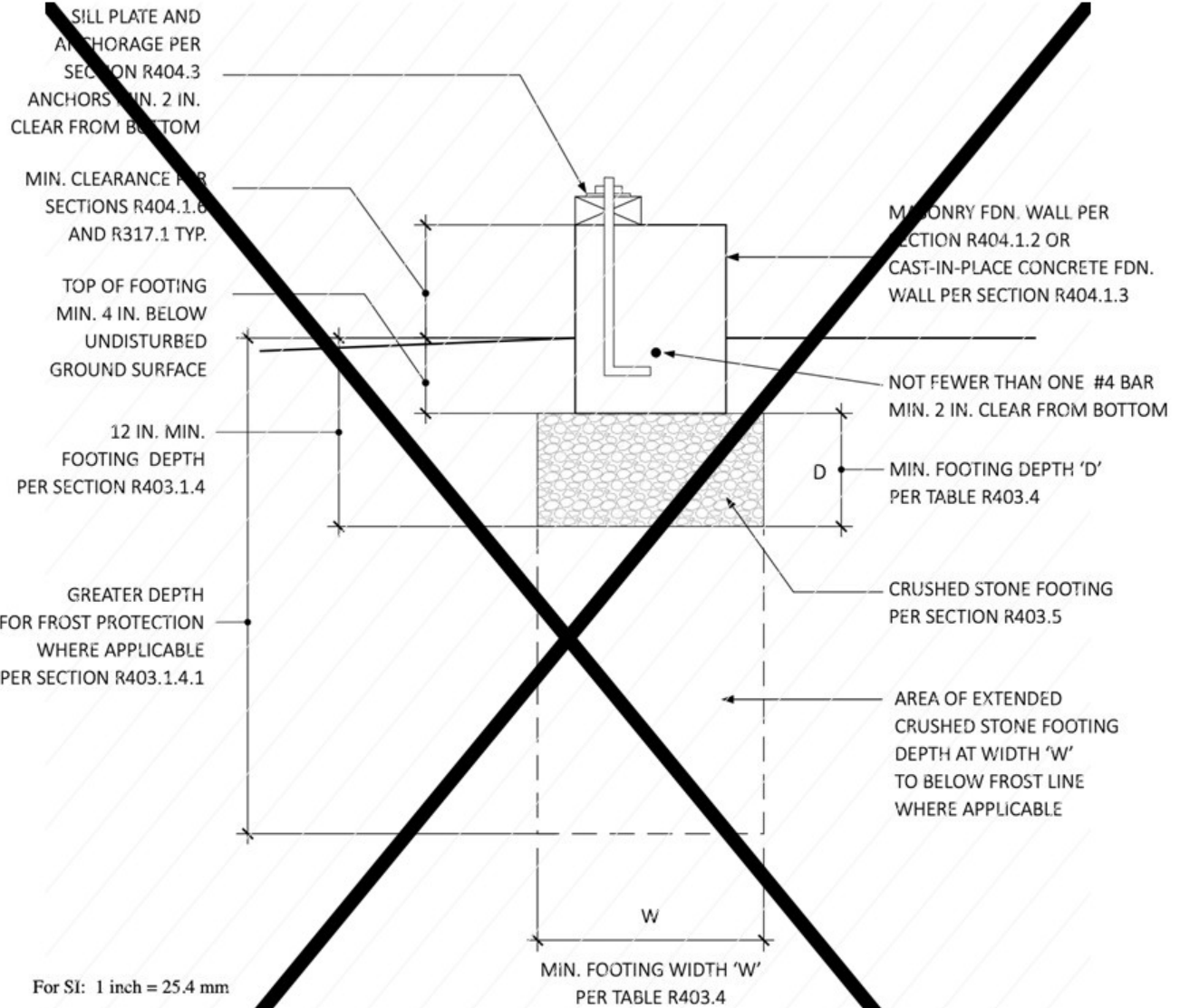
2021 International Residential Code

R403.1.1 Minimum size. The minimum width, W, and thickness, T, for concrete footings shall be in accordance with Tables R403.1(1) through R403.1(3) and Figure R403.1(1) or R403.1.3, as applicable, but not less than 12 inches (305 mm) in width and 6 inches (152 mm) in depth. The footing width shall be based on the load-bearing value of the soil in accordance with Table R401.4.1. Footing projections, P, shall be not less than 2 inches (51 mm) and shall not exceed the thickness of the footing. Footing thickness and projection for fireplaces shall be in accordance with Section R1001.2. The size of footings supporting piers and columns shall be based on the tributary load and allowable soil pressure in accordance with Table R401.4.1. Footings for wood foundations shall be in accordance with the details set forth in Section R403.2, and Figures R403.1(2) and R403.1(3). Footings for precast foundations shall be in accordance with the details set forth in Section R403.4, Table R403.4, and Figures R403.4(1) and R403.4(2). Crushed stone footings for ~~masonry or cast-in-place concrete foundations~~ shall be in accordance with Section R403.5.

R403.5 Crushed stone footings for cast-in-place concrete foundations. Crushed stone footings ~~for masonry or cast-in-place concrete foundations complying in accordance with Section R403.4.1 shall comply~~ shall be permitted for non-retaining cast-in-place concrete foundations complying with Section R404.1 R404.1.3 and this section except they. The footing and foundation wall shall be installed in accordance with Figures R403.5(1); or Figure R403.5(2) and Table R403.5, or Figure R403.5(3). Crushed stone footings for cast-in-place concrete foundations shall be permitted for townhouses in Seismic Design Categories A and B and one- and two-family dwellings in Seismic Design Categories A, B and C.

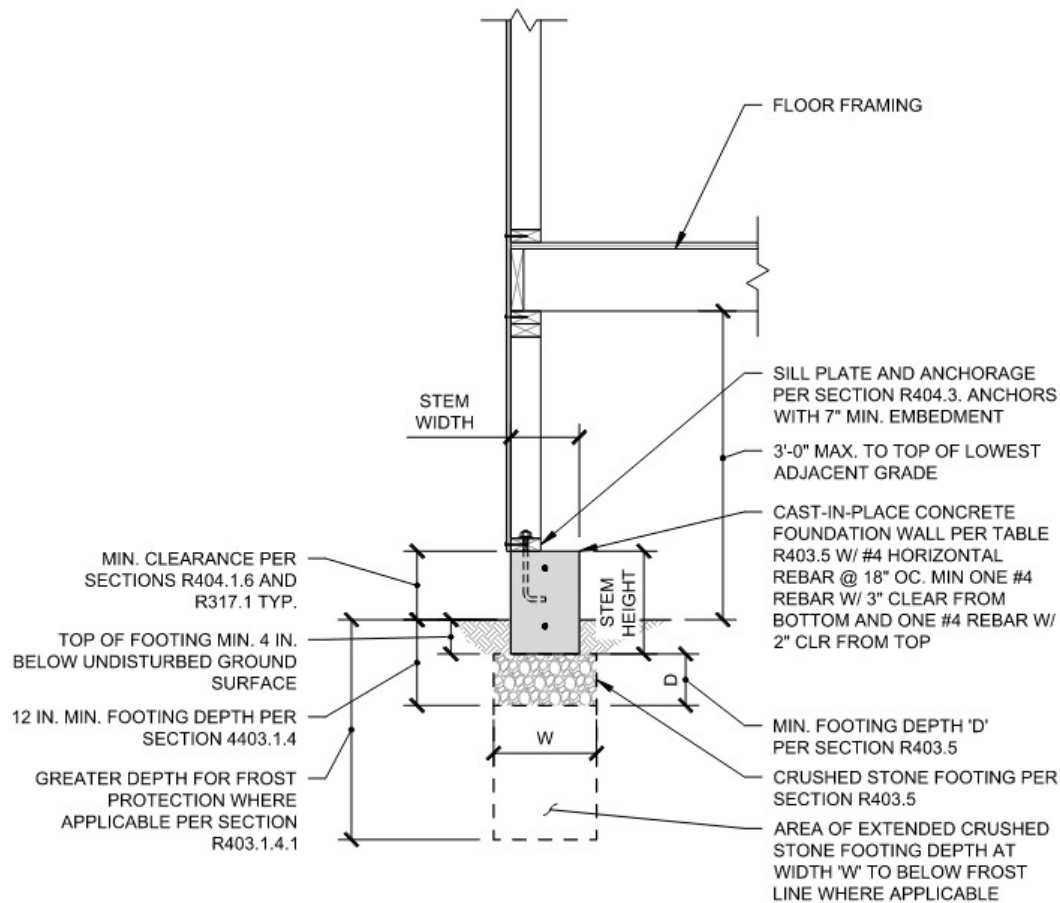
**TABLE R403.5 MINIMUM CAST-IN-PLACE CONCRETE FOUNDATION WALL DIMENSIONS, REINFORCEMENT, AND MAXIMUM
BRACED WALL LINE SPACING**

<u>WIND EXPOSURE CATEGORY</u>	<u>ULTIMATE DESIGN WIND SPEED (MPH)</u>	<u>MIN. STEM WALL WIDTH (IN.)</u>	<u>MIN. STEM WALL HEIGHT (IN.)</u>	<u>MIN. HORIZONTAL REBAR</u>	<u>MAX. BRACED WALL LINE SPACING (FT.)</u>
<u>B</u>	<u>< 140</u>	<u>6</u>	<u>12</u>	<u>(2) - #4</u>	<u>28</u>
<u>C and D</u>	<u>< 140</u>	<u>8</u>	<u>18</u>	<u>(3) - #4</u>	<u>25</u>



1 MASONRY OR CAST-IN-PLACE CONCRETE FOUNDATION WALL
NOT TO SCALE

FIGURE R403.5
CRUSHED STONE FOOTINGS
FOR CAST-IN-PLACE FOUNDATIONS
IN SEISMIC DESIGN CATEGORIES A, B, AND C



For SI: 1 inch = 25.4 mm

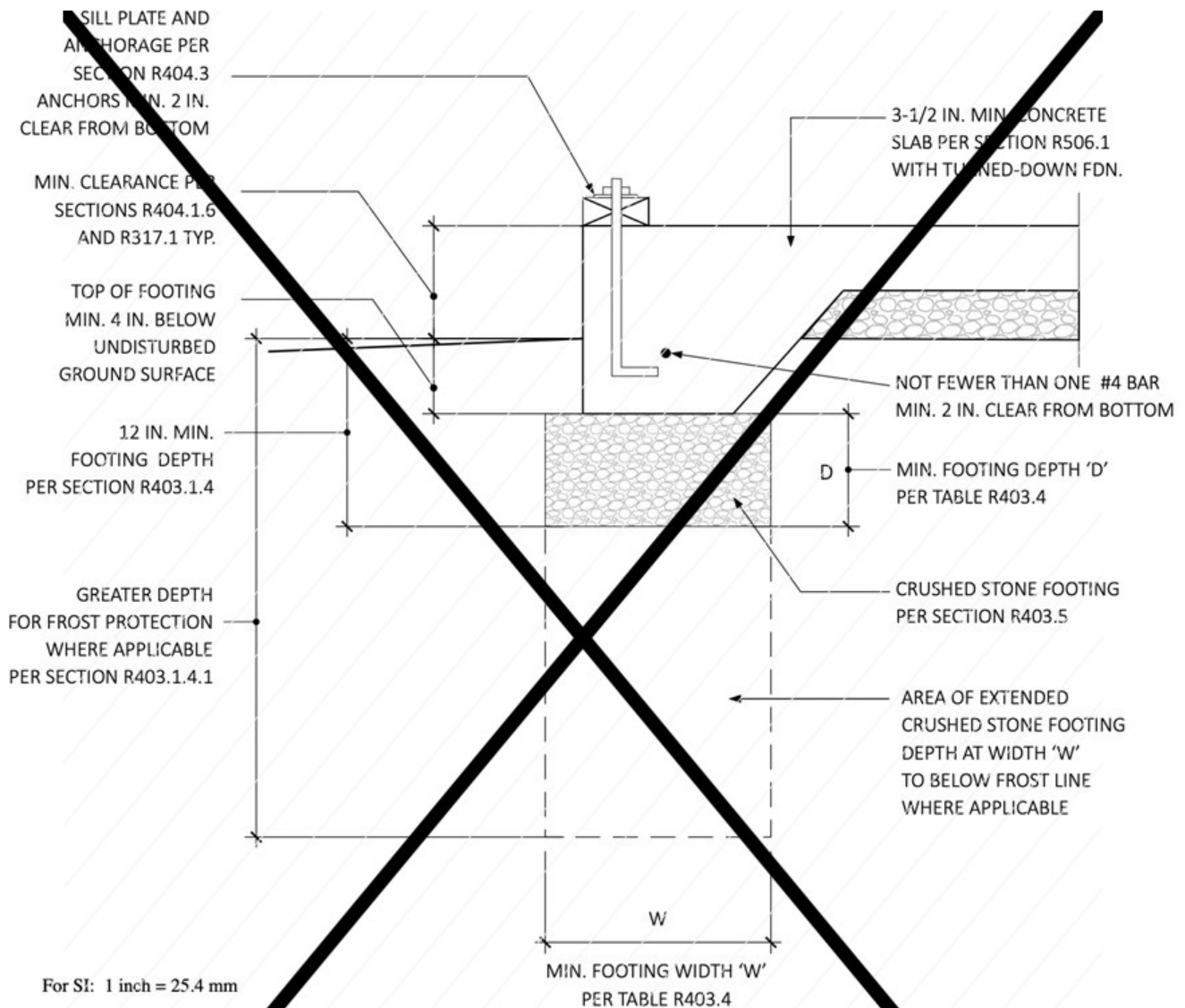
1

CAST-IN-PLACE CONCRETE FOUNDATION

WALL W/ WOOD CRIPPLE WALL

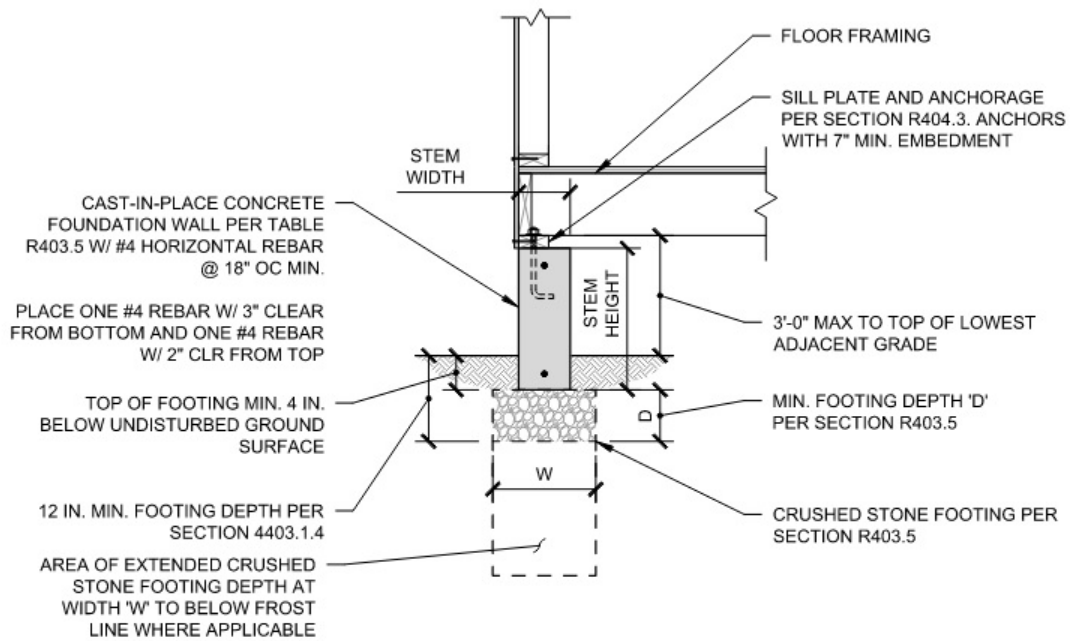
NOT TO SCALE

FIGURE R403.5(1) CRUSHED STONE FOOTINGS FOR CAST-IN-PLACE CONCRETE FOUNDATIONS IN SEISMIC DESIGN CATEGORIES A, B, AND C AND WIND EXPOSURE CATEGORIES B, C, AND D - CAST-IN-PLACE CONCRETE FOUNDATION WALL WITH WOOD CRIPPLE WALL

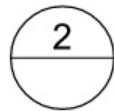


2 CONCRETE SLAB-ON-GROUND WITH TURNED-DOWN FOUNDATION
NOT TO SCALE

FIGURE R403.5
CRUSHED STONE FOOTINGS
FOR CAST-IN-PLACE FOUNDATIONS
IN SEISMIC DESIGN CATEGORIES A, B, AND C



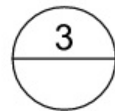
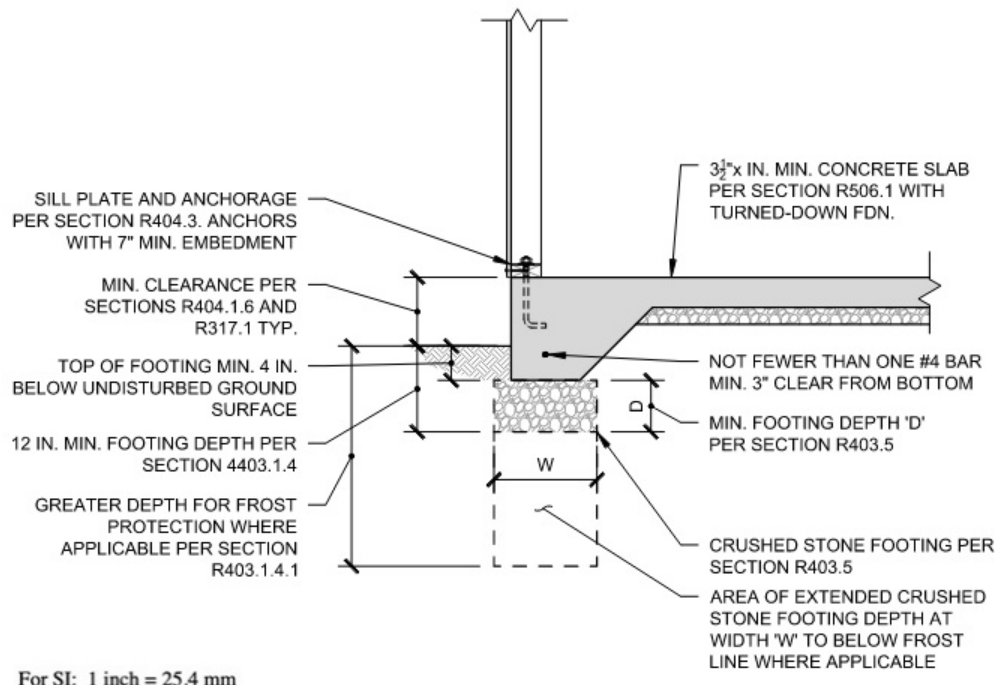
For SI: 1 inch = 25.4 mm



CAST-IN-PLACE CONCRETE FOUNDATION W/ NO CRIPPLE WALL

NOT TO SCALE

FIGURE R403.5(2) CRUSHED STONE FOOTINGS FOR CAST-IN-PLACE CONCRETE FOUNDATIONS IN SEISMIC DESIGN CATEGORIES A, B, AND C AND WIND EXPOSURE CATEGORIES B, C, AND D - CONCRETE SLAB-ON-GROUND WITH TURNED DOWN FOUNDATION CAST-IN-PLACE CONCRETE FOUNDATION WALL WITH NO CRIPPLE WALL ABOVE



CONCRETE SLAB-ON-GROUND W/ TURNED-DOWN FOUNDATION

NOT TO SCALE

R403.5(3) CRUSHED STONE FOOTINGS FOR CAST-IN-PLACE CONCRETE FOUNDATIONS IN SEISMIC DESIGN CATEGORIES A, B, AND C AND WIND EXPOSURE CATEGORIES B, C, AND D - CONCRETE SLAB-ON-GROUND WITH TURNED DOWN FOUNDATION

Commenter's Reason: Crushed stone footings for wood foundations and precast concrete foundations are currently permitted in IRC Sections R403.2 and R403.4.1 respectively. Proposal RB166 as modified by this Public Comment simply allows these provisions with similar or greater limitations to be used for cast-in-place concrete foundation walls and concrete slabs with turned-down foundations. This Public Comment maintains key aspects of the original proposal, while making modifications that address concerns expressed in CAH testimony or by IRC Committee comments, or that further limit its use.

A. Key Aspects of the Original Proposal Maintained:

1. Like the original proposal the modified proposal uses identical requirements for crushed stone and its placement as those for analogous precast concrete foundations in Section R403.4.1 (by reference), and for footing width and depth in the associated Table R403.4.
2. Conservatively, #4 bars are required for cast-in-place foundation walls over a crushed stone footing and turned-down foundations for slabs. Minimum clearances and quantities for the #4 bars and embedment for the sill plate anchors are stated in the Figures. By comparison, no reinforcing is currently required in the IRC for plain concrete footings and their foundation walls, or turned-down foundations in Seismic Design Categories A, B, and C.
3. Limited to use for one- and two-family dwellings in Seismic Design Categories A, B, and C.

B. Public Comment Modifications Addressing Concerns Expressed at the CAH:

1. Limited to use for townhouses in Seismic Design Categories A, B, consistent with the split in Section R301.2.2. (An appropriate clarification suggested by FEMA representatives.)
2. For non-retaining use only. (An appropriate limitation identified by FEMA representatives.)
3. The prescribed stem walls have been analyzed for resistance to out-of-plane wind and seismic design loads and their lateral span limits between perpendicular braced wall lines and their associated foundations. The maximum spacing of perpendicular braced wall lines is listed in the newly proposed Table R403.5. (Addresses the out-of-plane resistance concern raised by FEMA representatives.) (See <https://verdantstructural.com/RB166-22-crushed-stone-footing-calculation-packet.pdf> for supporting calculations.)
4. The provisions are now entirely prescriptive, no longer requiring an engineered design. (The engineered design requirement, added as a floor modification at the CAH to address FEMA representatives' concerns that are now addressed in this Public Comment, was a primary reason the IRC

Committee disapproved RB166. The IRC's stated purpose is to provide prescriptive requirements.)

C. Improvements or Additional Limitations:

1. New or revised Figures R403.5(1), (2), and (3) illustrate the requirements of these provisions, referencing applicable section numbers. The Figures illustrate three conditions: (1) concrete foundation wall with a cripple wall (added with this Public Comment), (2) concrete foundation wall with no cripple wall, and (3) concrete slab-on-ground with turned-down foundation.

2. Removes masonry foundation walls, therefore is allowed for cast-in-place concrete foundation walls only.

The foundation drainage concern expressed by an IRC Committee member was explained in CAH proponent testimony. That is, the same requirements in the IRC for other foundation and footing systems apply to this crushed stone footing use. More specifically, foundation drainage in the IRC is required only for "... foundations that retain earth and enclose habitable or usable spaces located below grade." (Section R405.1). This Public Comment and Proposal allow neither. However, crushed stone footings provide potential beneficial use as a foundation drainage medium, as alluded to in some subsections of Section R405.1.

Bibliography: <https://verdantstructural.com/RB166-22-crushed-stone-footing-calculation-packet.pdf>

Cost Impact: The net effect of the public comment and code change proposal will decrease the cost of construction

This Proposal allows the less material-intensive, less labor-intensive and therefore less expensive footing option of crushed stone instead of concrete for cast-in-place foundation walls, though this cost savings is partly offset by required reinforcing steel in the foundation wall or turned-down foundation of a slab.

Public Comment# 3358

Proposed Change as Submitted

Proponents: Anthony Dente, representing Verdant Structural Engineers (anthony@verdantstructural.com); Martin Hammer, representing Martin Hammer, Architect (mfhammer@pacbell.net); David Eisenberg, representing DCAT (strawnet@gmail.com); Kevin Donahue, representing Verdant Structural Engineers (kevin@verdantstructural.com); David Rich, representing Reax Engineering Inc. (rich@reaxengineering.com)

2021 International Residential Code

Revise as follows:

AU108.1 Fire-resistance rating. ~~Cob walls are not fire-resistance-rated.~~ Cob walls that comply with Table AU108.1 shall be considered to provide a two-hour fire-resistance rating.

Add new text as follows:

Original Proposal

TABLE AU108.1 TWO-HOUR FIRE-RESISTANCE RATED COB WALLS

<u>Allowable superimposed load (plf)</u>	<u>Density^a (pcf)</u>	<u>Minimum compressive strength per Section AU106.6.1 (psi)</u>	<u>Wall type reinforcement per Table AU105.3</u>	<u>Minimum thickness^c at top of wall (inches)</u>	<u>Minimum thickness^c at bottom of wall (inches)</u>
1,200	100	85	E	9	12
	50 pcf for the top 40 inches of wall height, maximum	40 ^b			
475	70 pcf for the top 80 inches of wall height, maximum	55 ^b	E or F	8	12
non load-bearing	50 to 100 ^d	>60 psi	E or F	9	9
		<60 psi ^b			

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound = 0.45 kg

- Density is to be measured at equilibrium moisture content. Average wall density shall be within +/- 5 pcf of the tabulated value.
- Requires an *approved* engineered design per Section AU106.6.
- Cob thickness only. The interior and exterior cob faces shall be permitted to be unfinished or receive any plaster finish allowed by this appendix.
- Cob walls with more than one density shall be built with heavier densities below lighter densities.

Revise as follows:

TABLE AU105.3 OUT-OF-PLANE RESISTANCE METHODS AND UNRESTRAINED WALL HEIGHT LIMITS

WALL TYPE ^{a, g, h} AND METHOD OF OUT-OF-PLANE LOAD RESISTANCE	FOR ULTIMATE DESIGN WIND SPEEDS (mph)	FOR SEISMIC DESIGN CATEGORIES	UNRESTRAINED COB WALL HEIGHT $H^{b, c}$		TOP ANCHOR ^e SPACING (inches)	TENSION TIE ^f SPACING (inches)
			Absolute Limit (feet)	Limit Based on Wall Thickness T^d (feet)		
Wall 1 ⁱ : no anchors, no steel wall reinforcing	≤ 110	A	$H \leq 8$	$H \leq 6T$	None	48
Wall 2: top anchors, ^j continuous vertical 6" x 6" x 6" 6-inch x 6-inch 6-gage steel mesh in center of wall embedded in foundation 12 inches	≤ 140	A, B, C	$H \leq 8$	$H \leq 8T$	12	24
Wall A ⁱ : top anchors, no vertical steel reinforcing	≤ 120	A, B	$H \leq 8$	$H \leq 6T$	12	48
Wall B ⁱ : top and bottom anchors, no vertical steel reinforcing	≤ 130	A, B	$H \leq 8$	$H \leq 6T$	12	48
Wall C: top and bottom anchors, continuous vertical threaded rod at 4 feet on center embedded in foundation and connected to bond beam	≤ 140	A, B, C	$H \leq 8$	$H \leq 8T$	12	24
Wall D: continuous vertical threaded rod at 1 foot on center embedded in foundation and connected to bond beam	≤ 140	A, B, C	$H \leq 8$	$H \leq 8T$	N/A	24
Wall E: top anchors, continuous vertical 6" x 6" x 6" 6-inch x 6-inch 6-gage steel mesh 2 inches from each face of wall embedded in foundation	≤ 140	A, B, C	$H \leq 8$	$H \leq 8T$	12	24
Wall F: top anchors, continuous vertical 6-inch x 6-inch 10-gage steel mesh 2 inches from each face of wall embedded in foundation	≤ 140	A, B, C	$H \leq 8$	$H \leq 8T$	12	24

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 mile per hour = 0.447 m/s.

N/A = Not Applicable

- See Table AU106.11(1) for reinforcing and anchorage specifications for wall Types A, B, C, D and E.
- H = height of the cob portion of the wall only. See Figure AU101.4. The maximum H is the absolute limit or the limit based on wall thickness, whichever is more restrictive.
- Bond beams or other horizontal restraints are capable of separating a wall into more than one unrestrained wall height with an approved engineered design.
- T = Cob wall thickness (in feet) at its minimum, without plaster.
- $5/8$ -inch threaded rod anchors at prescribed spacing with 12-inch embedment in cob, full embedment in concrete bond beams or full penetration in wood bond beam with a nut and washer.
- Attach rafters to bond beam with 4-inch by 3-inch by 3-inch by 18 gage tension tie angles at prescribed spacing. See Figure AU106.9.5. Where rafters are attached to tension ties, roof sheathing shall be edge nailed.
- All walls shall be tested for compressive strength in accordance with Section AU106.6.
- For curved walls with an arc length to radius ratio of 1.5:1 or greater, the H/T factor shall be increased by 1, and the absolute height limit by 1 foot.
- Wall type requires a modulus of rupture test in accordance with Section AU106.7.
- See wall Type A in Table AU106.11(1) for top anchor requirements.

Reason: A fire-resistance-rated cob wall assembly is added based on ASTM E119 test reports and an accompanying letter from the NTA/ICC testing engineers as well as Reax Engineering, which can be found at: <https://www.cobcode.org/cobcode-documents>. All Elements of Row 1 and 2, except for column 1 row 1 are references to the exact assembly tested in the ASTM E119 test with a field-common, 5% margin allowance for density. The requirement of column 1, row 1 is based on the ASTM E119 test and accompanying Engineering Judgment letters from NTA/ICC engineers and Reax Engineering. The requirement in footnote c is based on the unplastered assembly that was tested in the ASTM E119 test with the conservative allowance of the optional addition of plaster. The final row on the chart is based on conservatively removing the allowable superimposed load for the range of densities (50-100 pcf) tested in the ASTM E119 test. The reinforcing matches the ASTM E119 tests and the minimum thickness matches the minimum thickness of the ASTM E119 test for the highest density present (100pcf). An additional wall assembly

was added to Table AU105.3 to allow for the exact gauge of reinforcing steel used in one of the ASTM E119 tests. Concerning out-of-plane loading, this system is stronger than the one tested and governing Table AU105.3, therefore this addition is conservative.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This change simply offers options for tested fire-resistance-rated cob walls, which are no more costly than other non-rated cob walls.

RB310-22

Public Hearing Results

Committee Action:

Disapproved

Committee Reason: This proposal for the appendix for Cob Construction was disapproved because there was concern that only two systems were tested, and it seems like the codes require every potential variable for other wall assemblies and other materials in the codes. Some felt this proposal does clarify the direction to achieve a fire resistance rating. (Vote: 6-3)

RB310-22

Individual Consideration Agenda

Public Comment 1:

IRC: AU108.1, TABLE AU108.1

Proponents: Anthony Dente, representing Verdant Structural Engineers (anthony@verdantstructural.com); David Eisenberg, representing DCAT (strawnet@gmail.com); Martin Hammer, representing Martin Hammer, Architect (mfhammer@pacbell.net); David Rich, representing Reax Engineering Inc. (rich@reaxengineering.com) requests As Modified by Public Comment

Modify as follows:

2021 International Residential Code

AU108.1 Fire-resistance rating. Cob walls that comply with Table AU108.1 ~~shall be considered to provide~~ have a two-hour fire-resistance rating.

TABLE AU108.1 TWO-HOUR FIRE-RESISTANCE RATED COB WALLS

Allowable superimposed load (plf)	Density ^{a,d} (pcf)	Minimum compressive strength per Section AU106.6.1 (psi)	Wall type reinforcement per Table AU105.3	Minimum thickness ^{c,e,f} at top of wall (inches)	Minimum thickness ^{c, e,f} at bottom of wall (inches)
1,200	100 ≥ 50 pcf: top of wall to for the top 40 inches from top of wall height, maximum.	85 40 ^b	E	9	12
475	≥ 70 pcf: 40 inches from for the top of wall to 80 inches from top of wall height, maximum. ≥ 90 pcf: 80 inches from top of wall to bottom of wall.	55 ^b 85	E or F	8	12
non load-bearing	50 to 100 ^d	> ≥ 60 psi < 60 psi ^b	E or F	9	9

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound = 0.45 kg

- a. Density is to be measured at equilibrium moisture content. Average wall density shall be within +/- 5 pcf of the tabulated value.
- b. Requires an *approved* engineered design per Section AU106.6.
- c. Cob thickness only. The interior and exterior cob faces shall be permitted to be unfinished or receive any plaster finish allowed by this appendix.
- d. Cob walls with more than one density shall be built with heavier densities below lighter densities.
- e. Minimum cob wall thickness shall be whichever is greater in Table AU105.3, Table AU106.11(1) and Table AU108.1.
- f. Wall thicknesses less than 10" require an engineered design.

Commenter's Reason: In both opposition testimony and comments by the IRC Committee inaccurate statements were made at the CAH that created unwarranted doubt or confusion about this proposal. These include that multiple tests are required for an assembly or material to be given a fire-resistance rating in the code; that only one test had been performed; and that the proposal did not specify material makeup requirements to ensure that constructed rated walls would match what was tested. In addition to refuting those incorrect assertions, this Public Comment rewords some of RB310-22's code language to address legitimate concerns raised at the CAH and makes other improvements for greater clarity. First, the language in the IRC and IBC indicates that a fire-resistance rating can be attained for an assembly by passing the required test, in this case ASTM E119 or UL 263 for walls. There is no language in the code requiring multiple tests to receive recognition as a rated assembly. Only that the required test is performed by an approved lab, is successful, properly documented, and that the code requirements for the rated assembly or material match what was tested, all of which the proposed code change in RB310 does. The proposed Table AU108.1 provides options by carefully matching what was tested to what is required for a fire-resistance rated cob wall. Additional footnotes further clarify the limitations and requirements in this table.

This is not a case where the tested walls barely passed the fire tests, or that a change in material makeup allowable in Appendix AU could affect the fire-resistance of the wall. Two full-scale 2-hour ASTM E119 tests were conducted with virtually no heat rise on the cool side of the wall, and both then passed the hose stream test. Importantly, the same materials required or allowed for cob walls in this appendix and this code change proposal – clay soil, sand and straw - have been used for centuries to build ovens and kilns specifically because of their ability to contain fire.

Cob density is governed by the proportion of straw in the mix. Within the material requirements of Appendix AU and density range tested and allowed in this proposal, there is no material makeup that wouldn't easily achieve a 2-hour rating. Furthermore, Appendix AU requires a shrinkage test (Section AU103.4.1) for *all* cob mixes, to minimize or eliminate cracking in service. This ensures that a rated cob wall subjected to fire, regardless of its exact material makeup, will not contain cracks that could compromise its ability to perform to its rated fire-resistance.

As stated in support testimony, the original proposal for Appendix AU for the 2021 IRC included a 1-hour fire-resistance rating without an ASTM E119 or UL 263 test, which drew opposition that resulted in disapproval at the 2019 CAH. A subsequent public comment removed the fire rating, resulting in the approval of Appendix AU. RB310-22 directly follows the recommendations of the committee and those who spoke in opposition, by conducting the needed testing and providing associated code provisions for those rated walls. The testing conducted and documented is more than adequate to support the proposed fire-resistance ratings for the cob walls described in RB310.

It should be noted that the fire-safety experts who opposed Appendix AU's original proposal because of the lack of testing, were consulted about the

ASTM E119 tests conducted and the test results were shared with them in preparation for the RB310 code change proposal. They testified in support of RB310 at the CAH. Also, individuals who testified in opposition to the current proposal at the CAH were engaged before the Public Comment was submitted. Misunderstandings were clarified and we attempted to address their concerns.

Second, two cob walls were tested, each with differing densities and thickness, and both easily passed ASTM E119 2-Hour tests, including the hose stream test. Several comments in testimony claimed only one test was performed. Laboratory reports of the tests were and are available at a linked website (see below) along with other supporting information.

Third, the specifics of the two tested walls are reflected in the requirements in RB310's Table AU108.1, with corresponding densities, compressive strength, reinforcement, and thickness. One tested wall contained three densities from bottom to top, that all performed exceedingly well in the test. The other wall was of a different, single density. Thus, four different densities ranging from 50 pcf to 100 pcf, were tested and proven to easily pass the 2-hour E119 fire test.

Fourth, for important context: Australia has had standards for earthen wall systems including for fire safety for decades. The Australian Earth Building Handbook, HB195-2002, in Section 4.6 Fire Resistance Level, states, "In the absence of specific test data, the general fire resistance level (FRL) of earth walls satisfying the minimum thickness requirements outlined in Clause 4.3.4 may be taken as not greater than 120/120/120, or 90/90/90 where wall thickness is less than 200 mm." Clause 4.3.4 Structural Adequacy states: "Minimum recommended thicknesses for mud brick, stabilized pressed block and rammed earth are as follows: External walling - 200 mm, Internal walling - 125 mm. The minimum wall thickness for poured earth and cob wall construction is also recommended to be 200 mm, though in practice wall thickness will often exceed this value."

The three numbers in the FRL represent minutes before failure for structural adequacy/integrity/insulation. In other words, the time for the wall to be able to maintain a load, maintain its integrity, and before heat increase on the unheated side of the wall exceeds accepted limits. Thus, Australia gives a 2-hour fire resistance rating for a 200 mm (7.87") earth wall, including for cob walls.

Further, Australian Standard AS 3959-2009, "Construction of Buildings in Bushfire-Prone Areas," was produced in response to the many severe bushfires they have suffered. Based on the actual performance of earthen wall buildings in Australia, mud brick with a minimum thickness of 90mm (3.54") is listed as one of only three exterior wall materials allowed to be used in the highest bushfire exposure zones without need of additional testing (the other two being full masonry and concrete). The minimum thickness of cob walls in this public comment is 8 inches, more than double the minimum thickness in the Australian standard. These Australian documents are available via the supporting documents

link: <https://www.cobcode.org/cobcode-documents>

See photo below of one of two cob wall specimens tested at the independent testing laboratory.



Bibliography: The test reports and other supporting documents for this Public Comment as well as the code change proposal and the original proposal for Appendix AU are available for download and review here: <https://www.cobcode.org/cobcode-documents>

Cost Impact: The net effect of the public comment and code change proposal will not increase or decrease the cost of construction. This change simply offers options for tested fire-resistance-rated cob walls, which are no more costly than non-rated cob walls.