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2022 TMS 402/602 Committee
Proposed Negative Resolution to Masonry Standard

Committee: Main Committee	**Ballot #: 21**
Item #: 21-CR- 001A	
Technical Contact/Email: John Chrysler, jc@masonry.pro	
Resolving Negative on Ballot Item: Main Committee ballot item 20-CR-001 (PC 049)	
Negative Voter(s): Heather Sustersic	
This ballot item proposes to find negative(s): ☒ ***Persuasive, Substantive*** ☐ ***Persuasive, Editorial*** ☐ ***Non-persuasive*** ☐ ***Unrelated***	

Negative:

The slump requirements of TMS 602 Articl 2.6 B.2 are certainly helpful and should be referenced if this situation recurrs, but what if the contractor argues that a piece of hardened grout is not "grout" but a "bar positioner"? There is no language currently in the code or specification that constrains the maximum size/thickness of a bar positioner nor on the maximum obstruction that it can pose within the grouted cell. TMS 602 Commentary figure SC-11 shows examples of typical bar positioning devices, but no where do we define or limit what can be called a "bar positioner". What prevents the use of a wood block as a bar positioner? I think there is room for improvement and clarification here. One suggested way would be to define a maximum size of obstruction that a bar positioner can introduce. Perhaps referencing back to the maximum reinforcement percentages in TMS 402 6.1.3 and the definition of gross grout space would be a good starting point.

To aid the subcommittee, consider expanding TMS 602 article 3.4B as follows:
1. Support reinforcement to prevent displacement caused by construction loads or by placement of grout or mortar, beyond the allowable tolerances. Reinforcement supports shall not exceed the percentages of the gross grout space defined by TMS 402 Table 6.1.3.2.5, Table 6.1.3.2.5.1, or Table 6.1.3.2.5.2, taking the area of vertical reinforcement and the area of horizontal reinforcement into account.

Rationale:

CR requests Main Committee find this negative response persuasive in order to kill Main 20-CR-001. Another ballot item with this language is poroposed in Ballot 21-CR-001B.

Subcommittee Vote:				
0 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: N/A

This ballot item submitted by Chair in accordance with Technical Committee Operations Manual Section 4.2.1. This ballot item is needed to validate Ballot Item 21-CR-001B.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee			**Ballot #: 21**
Item #: 21-CR- 001B			
Technical Contact/Email:	Jonathon R. Merk / jon@forrestassociate.com		
Draft Document Dated:	**10/26/2021**		
Reballot of Main Committee Item No.: N/A	**Response to TAC Comment No.:** N/A	**Response to Public Comment No.:** 049	
Reference *(Choose from Drop-Down Menu)*	**Section/Article**		
TMS 602 Specification Article	3.4 B.1		

Public Comment:

We recently had a project where partial grout was used onsite as a bar positioner in select cells during construction in a toothed wall intersection, but the grout lift height is defined in TMS 602 commentary section 3.5D as "the height to which grout is placed into masonry in one continuous operation." By that definition, grout should not be packed/used intermittently as a means of bar positioning. The grout lift definition appears only in the commentary of TMS 602. Specification TMS 602 3.4 B.1 states that bars must be "supported" to prevent displacement during grout placement, but it does not limit the ways that this can be accomplished. The accompanying commentary 3.4.c requires that "there is sufficient clearance for grout and mortar to surround reinforcement, ties, and anchors so stresses are properly transferred." Arguably, partial grouted bar positioning prevents proper consolidation for the final grout pour does not provide 'sufficient clearance' around the bars, but without a codified definition of grout lift height, there is nothing to prevent the contractor from packing grout to hold bars in place. Consider adding the definition of 'grout lift height' to chapter 2 to require grout to be placed in one continuous operation, as intended.

Rationale: *(Rationale is explanatory and not part of the proposed revision)*

Main Cmte. ballot item 20-CR-001 addressed a public comment detailing how a mason dry packed grout around vertical reinforcement in order to position / support the bar. While CR received Main Cmte.'s approval of the response to that public comment, a negative response pointed out that other materials could be substituted for the dry packed grout that would create the same negative impact.

CR appreciates the comment and offers the following language proposed by the commenter.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code: N/A

Code Commentary: N/A

Specification:

3.4 B. *Reinforcement*

1. Support reinforcement to prevent displacement caused by construction loads or by placement of grout or mortar, beyond the allowable tolerances. Reinforcement supports shall not exceed the percentages of the gross grout space defined by TMS 402 Table 6.1.3.2.5, Table 6.1.3.2.5.1, or Table 6.1.3.2.5.2, taking the area of vertical and horizontal reinforcement into account.

Specification Commentary: N/A

Mandatory Requirements Checklist: N/A

Optional Requirements Checklist: N/A

Subcommittee Vote:				
11 *Affirmative*	1 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	1 *Did not vote*

Subcommittee Comments: N/A

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee			**Ballot #: 21**
Item #: 21-CR- 002			
Technical Contact/Email:	Jonathon R. Merk / jon@forrestassociate.com		
Draft Document Dated:	**10/26/2021**		
Reballot of Main Committee Item No.: N/A	**Response to TAC Comment No.:** N/A	**Response to Public Comment No.:** 152	
Reference *(Choose from Drop-Down Menu)*	**Section/Article**		
TMS 602 Commentary Article	Figure SC-11		

Rationale: *(Rationale is explanatory and not part of the proposed revision)*

Main Cmte. ballot item 20-CR-005 received an AWC response suggesting a revision to the title of Figure SC-11 in order to help clarify that positioners are not required by Code. CR concurs and offers the following proposed revision suggested in the AWC.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code: N/A

Code Commentary: N/A

Specification: N/A

Specification Commentary:

Figure SC-11 – ~~Typical~~ Examples of positioners for reinforcement

Mandatory Requirements Checklist: N/A

Optional Requirements Checklist: N/A

Subcommittee Vote:				
12 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	1 *Did not vote*

Subcommittee Comments: N/A

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-DE- PC 171	
Technical Contact/Email: Patrick Dillon, pdillon@wdpa.com;	
Public Comment Number: 2022 Comment # 171	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☐ ***Committee agrees with Public Comment, change is proposed***

☒ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

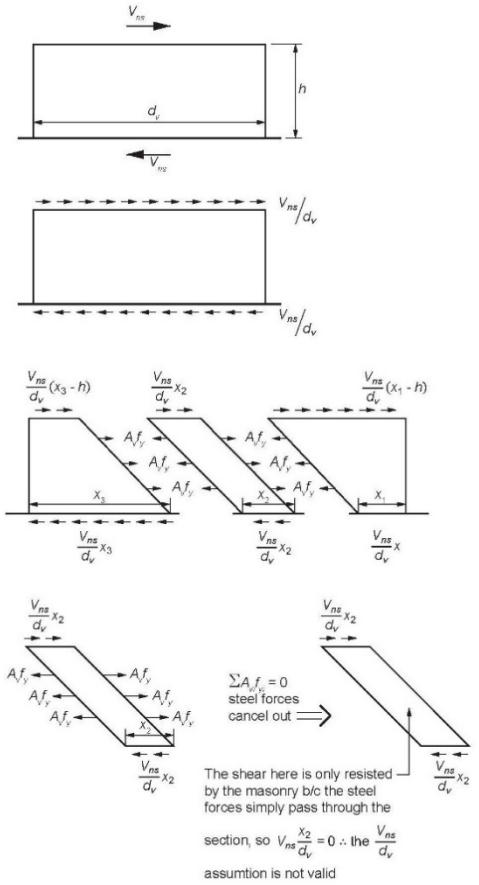
Public Comment:

Public Comment 171 reads as follows:

> Page 170, Line 1, Figure CC-9.3-1
> I admire the simplicity of the figures in attempting to concisely explain Vns, but unfortunately I have some concerns about them, more particularly about (b).
>
> Item 1.
> The commentary notes that only the horizontal forces are shown for clarity. The diagrams are in equilibrium in in the x direction but are not in equilibrium for in-plane rotation. This means that additional forces are required, or the assumed stress distribution in the reinforcement is not correct, or both.
>
> Equilibrium could be attained in diagram (a) reasonably easily because vertical forces from the vertical reinforcement, axial load, and masonry compressive stress block are all within the wedge. This makes sense because it has a high aspect ratio.
>
> However, I have tried multiple approaches to find a complete set of free body diagrams for (b) that are at least somewhat consistent with the other forces and reactions and satisfy equilibrium, but have not been able to find anything where the x value cancels out of the equation. The equation assumptions do not appear to be valid or are only valid for a crack at a specific location and with a specific combination of loads.
>
> Item 2.
> I will send a figure to accompany this comment item but will try to walk the reader through it textually as well. This item will only consider the forces in the horizontal direction, as assumed in the commentary. The free body diagram in (b) works for a single crack. But consider the scenario where two or more parallel cracks form. Assume they form at a 45-degree angle, similar to the figure.
>
> Now, construct a free body diagram for a strip of masonry running between two cracks. The strip will have a rhomboid shape. Assume the horizontal width of the strip at the top and bottom are x. Based on the commentary's assumptions, the shear force from Vns at the top and bottom will both equal Vns*x/dv. In addition, there will be multiple horizontal forces projecting out from both sides representing the horizontal reinforcement, with each force equal to Av*fy. Since the horizontal reinforcement forces on the two sides of the masonry strip are equal and opposite, they sum to zero. This means that the forces in the reinforcement pass through the strip from one side to the other side without transferring any load into or from the masonry strip.
>
> Since the shear reinforcement forces have no effect on the strip, an equivalent free body diagram could be constructed for the strip wherein the reinforcement forces are omitted and only the Vns*x/dv forces remain. In either case, the shear forces at the top

and bottom of the strip are resisted by the masonry itself. But this violates the assumptions of the figure because Vns is supposed to be resisted by the shear reinforcement, not the masonry. It appears that one or more of the figure's assumptions are not valid.

Conclusions
I do not think we should include figure (b) because the I have shown two different ways that the figure is not valid, first by showing that the assumptions do not satisfy equilibrium, and second by showing that it contradicts its own assumptions. It's a shame that it didn't work out since it's a simple explanation, but it's no surprise because there has been disagreement in the research community for years about the proper interpretation of the empirical shear equation. I recommend removing figure (b) entirely or, better yet, revising the shear strength equation to a form that has a solid mechanical basis and revising the figure to match. There has been a good amount of research on this latter topic in the past decade or so that could be used as a starting point.



Response/Rationale:

Masonry shear strength prediction is a topic that has been discussed for several decades within the masonry research community. The committee acknowledges that much additional research has been performed in the past three decades since the current shear equation was developed that may render it possible to develop an improved shear strength equation, but concedes that there is not sufficient time in this code cycle to adequately consider this topic. The committee will reconsider this topic during the next code cycle.

The public commenter suggests that the figure assumptions don't satisfy equilibrium. The committee notes that Figure CC-9.3-1 is intended to only represent an approximation of Equation 9-19 and is limited to horizontal forces and is intended to explain this equation. Language is proposed to provide additional background and clarify the commentary figure.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

References, Chapter 9

Anderson, D. L., and Priestly, M. J. N. (1992). "In Plane Shear Strength of Masonry Walls," *6th Canadian Masonry Symposium*, Saskatoon, Saskatchewan.

Code Commentary:

9.3.3.1.2.2 *Nominal shear strength provided by reinforcement* — The nominal shear strength provided by horizontal reinforcement, as given in Equation 9-19, is an empirical equation based on a best-fit analysis of fully-grouted masonry shear wall tests performed in the 1980s (Anderson and Priestley (1992)). While predominantly an empirical relationship, the form of Equation 9-19 can be approximately represented by the assumptions and free-body diagrams shown in Figure CC-9.3-1, where only horizontal forces are considered. ~~shown for clarity.~~ For walls ….

The empirical coefficient of 0.5 in Equation 9-19 can be considered to account ~~accounts~~ for the fact that not all the horizontal reinforcement may reach the yield strength when the nominal shear capacity of a wall is reached, partly due to the fact that reinforcement near the top or the bottom of a shear crack may not have adequate development lengths to develop the yield strength (Shing et al (1990a); Shing et al (1990b)). Other coefficients were evaluated (0.6, 0.8, and 1.0), but the best fit to the experimental data was obtained using the 0.5 factor (Davis et al (2010)).

Specification:

None

Specification Commentary:

None

Subcommittee Vote:				
14 *Affirmative*	2 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	4 *Did not vote*

Subcommittee Chair Comments: Changes were made in the ballot based on the Affirmative with comments see highlighted areas in the commentary changes and rationale.

This ballot item with revisions is submitted by Chair in accordance with Technical Committee Operations Manual Section 4.2.1. Technical input provided by Patrick Dillon and Mark McGinley.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-EX-001	
Technical Contact/Email: Dr. Mark McGinley (m.mcginley@louisville.edu)	
Public Comment Number: 2022 Comment # 04	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/4/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Rationale:

Ballot item 20-DE-004 was a ballot item in response to Public Comment #04. It moved the requirements for the specified compressive strength of masonry and grout from Chapter 9 and 11 to Chapter 4 so the limits would apply to allowable stress design as well as strength design. This ballot item passed with no negatives.

In entering the changes into the working draft, we realized that this section should be excluded from Chapter 15. This ballot item proposes to do that.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code: NONE

For voter convenience, the new Section 4.3 that was approved on 20-DE-004 is shown. The subsequent sections were renumbered. Changes are only being made to Section 15.2.2.1.

4.3 – Specified Compressive Strength

The specified compressive strength of masonry and grout shall meet the requirements of Table 4.3.1.

Table 4.3.1: Specified Compressive Strength Requirements

Type of masonry	Specified compressive strength of masonry	Specified compressive strength of grout
Concrete masonry	$f'_m \leq$ 4,000 psi (27.58 MPa)	$f'_g \geq f'_m$ $f'_g \leq$ 5,000 psi (34.47 MPa)
Clay masonry	$f'_m \leq$ 6,000 psi (41.37 MPa)	$f'_g \leq$ 6,000 psi (41.37 MPa).
AAC masonry	$f'_{AAC} \leq$ 290 psi (2.0 MPa)	$f'_g \leq$ 5,000 psi (34.47 MPa)

15.2.2 ***General***

15.2.2.1 The provisions of Part 1 and Part 2, excluding Sections 1.2.1(c), 1.2.2, 4.1, 4.2, 4.3, and ~~4.3~~4.4, shall apply to prescriptive design of masonry partition walls.

Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
0 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments:

This ballot item submitted by Chair in accordance with Technical Committee Operations Manual Section 4.2.1. Technical input provided by Dick Bennett, Mark McGinley and Charles Tucker.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-EX-002	
Technical Contact/Email: Jamie Farny, jfarny@cement.org	
Public Comment Number: 2022 Comment # 002	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☐ ***Committee agrees with Public Comment, change is proposed***

☒ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment #2:

Please consider updating all standards if newer editions can be referenced. For example try to reference ASCE/SEI 7-22 if possible. Use this comment to make needed references throughout TMS 402, TMS 602, and Commentaries.

Response/Rationale:

The committee updated all references on Ballot Items 20-EX-001 and 20-EX-002. As those revisions were being implemented in the TMS 402/602 draft, TMS staff pointed out that there were changes to technical content in ACI 117, *Specification for Tolerances for Concrete Construction and Materials (ACI 117-10) and Commentary-Reapproved 2015* between the 1990 and 2010 edition that are not appropriate for masonry construction.

The 1990 edition states that top of foundation elevation is allowed to vary by +/- 1/2 in. but in 2010 the minus side was increased to 2 in. for concrete construction. In order to maintain the appropriate +/- 1/2 in. for masonry construction, we need to reference the 1990 edition. Revert to the previous entry for ACI 117.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code: NONE

Code Commentary: NONE

Specification: NONE

Specification Commentary:

Part 3
ACI 117 (1990~~2010~~). *Standard Specifications for Tolerances for Concrete Construction and Materials*, American Concrete Institute.

Subcommittee Vote:				
0 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments:

This ballot item submitted by Chair in accordance with Technical Committee Operations Manual Section 4.2.1. Technical input provided by Jamie Farny.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-EX-003	
Technical Contact/Email: John Chrysler, jc@masonryinstitute.org	
Public Comment Number: 2022 Comment # 150	
Public Comment Response Based on TMS 402/602 Draft Dated	**11/5/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Rationale:

Ballot item 19-VG-150 changed Table 4.2.2 so that the elastic modulus for cast stone masonry was to be determined by test instead of using the ACI 318 equation. The approved change is shown below.

Table 4.2.2 Elastic Moduli

Material	Modulus of Elasticity	Modulus of Rigidity
Steel Reinforcement	E_s = 29,000,000 psi (200,000 MPa)	---
Prestressing Steel	E_{ps} shall be determined by tests or provided by manufacturer	---
Clay Masonry [2]	$E_m = 700\, f'_m$	$G = 0.4E_m$
Concrete Masonry [2]	$E_m = 900\, f'_m$	$G = 0.4E_m$
Cast Stone Masonry [2]	~~$E_{MCS} = 57{,}000\sqrt{f'_m}$~~ E_{MCS} shall be determined by tests or provided by manufacturer	--- ~~$G = 0.4\, E_{MCS}$~~
AAC Masonry	$E_{AAC} = 6500\,(f'_{AAC})0.6$	$G = 0.4E_{AAC}$
Grout	$E_g = 500\, f'_g$	---

It was discovered that the commentary also needs to change. This ballot item proposes to update the commentary to reflect the code change.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code: NONE

Commentary:

4.2.2 *Modulus of elasticity and modulus of rigidity*

~~*Cast stone* — For cast stone masonry, the elastic modulus is assumed to be similar to concrete, therefore, the equation from ACI 318 is used. Values for specific assemblies can be obtained through testing as outlined in the footnote to Table 4.2.2~~

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
0 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments:

This ballot item submitted by Chair in accordance with Technical Committee Operations Manual Section 4.2.1. Technical input provided by Dick Bennett and Jason Thompson.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-EX-004	
Technical Contact/Email: John Chrysler, jc@masonryinstitute.org	
Public Comment Number: 2022 Comment # 002	
Public Comment Response Based on TMS 402/602 Draft Dated	**11/5/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Rationale:

In updating the working draft it was noticed that we are very inconsistent in how we reference ACI 318. The ballot item proposes to provide some consistency, with the plan to do a thorough review next cycle.

Each change is independent of the others, and a negative on one item does not preclude the others from passing.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code: NONE

Commentary:

6.1.9 *Standard hooks and bends for reinforcing bars and deformed wire* - The concrete building code (ACI 318-19) treats deformed wire and bars identically in the range of 3/8 in. (9.5 mm) diameter to 5/8 in. (15.9 mm) diameter because testing has shown consistent behavior with the two materials.

(Note to voter: ACI 318-19 reference is added to Chapter 6 reference list; no change is being proposed to the commentary.)

9.3.5.6.2.4

This Code has adopted the stress-based triggers of ACI 318-99 for cases where the displacement-based approach is not applicable, simply changing the threshold values of 0.2 f_c' and 0.15 f_c' for reinforced concrete walls to 0.2 f_m' and 0.15 f_m', respectively, for reinforced masonry walls. Other aspects of the ACI 318-99 approach are retained. Design for flexure and axial loads does not change depending on whether the neutral axis-based trigger or the stress-based trigger is used.

(Note to voter: ACI 318-99 reference is added to Chapter 9 reference list; no change is being proposed to the commentary.)

10.3 — Permissible stresses in prestressing tendons

Allowable prestressing-tendon stresses are based on criteria established for prestressed concrete (ACI 318-19~~, 2011~~).

(Note to voter: Reference is updated to ACI 318-19 per direction from Prestressed subcommittee.)

10.4.3 *Strength requirements*

Calculation of the moment strength of prestressed masonry members is similar to the method for prestressed concrete members (ACI 318-19 ~~(2014)~~).

(Note to voter: Ballot item 20-EX-002 changed the reference in the reference list to ACI 318-19. The edition is changed in the commentary to match that change. The commentary is changed to reference ACI 318 in a consistent format with other references to ACI 318.)

10.10 — Prestressing tendon anchorages, couplers, and end blocks

Additional guidance on design and details for post-tensioning anchorage zones is given in Section 25.9 of ACI 318-19 ~~(2014)~~, as well as other references (Sanders et al (1987)).

(Note to voter: Ballot item 20-EX-002 changed the reference in the reference list to ACI 318-19. The edition is changed in the commentary to match that change. The commentary is changed to reference ACI 318 in a consistent format with other references to ACI 318.)

REFERENCES

References, Chapter 6

ACI 318 (2019). *Building Code Requirements for Reinforced Concrete*, American Concrete Institute.

References, Chapter 9

ACI 318 (1999). *Building Code Requirements for Reinforced Concrete*, American Concrete Institute.

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
0 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments:

This ballot item submitted by Chair in accordance with Technical Committee Operations Manual Section 4.2.1. Technical input provided by Dick Bennett.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-GR-044	
Technical Contact/Email: Charles Clark / cclark@bia.org	
Public Comment Number: 2022 Comment # 44	
Public Comment Response Based on TMS 402/602 Draft Dated	**11/5/2021**

This ballot item proposes the following response to the Public Comment:

☐ ***Committee agrees with Public Comment, change is proposed***

☒ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment: Specification MANDATORY REQUIREMENTS CHECKLIST, Page 394, Lines 13 through 63.

The TMS 602 requires that the Architect/Engineer specify the location of movement joints on the project drawings. Frequently, many Architects/Engineers will include a general note such as "Provide control joints at 25'-0" maximum" without physically locating the joints in plan or elevation which can lead to issues at flanged shear walls, lintels designed based on arching action, and wall intersections. AISC 341 requires a restricted zone for moment frame connections and for braced frames. The mandatory checklist could be more specifically, such as: "Indicate type and location of movement joints on the project drawings and specifically show graphically in plan or elevation locations where movement joints are not permitted." This would allow the contractors flexibility to place the joints in the wall without worrying about compromising the structural intent.

Response/Rationale:

This is the second proposal to attempt to address this public comment. The content of the public comment is related to Code Section 1.2.1 that has been debated many times. This proposal addresses some of the comments resulting from the first proposal identified as 20-GR-044. In keeping with the intent of the current text in the Code, in the Specification, and in the Mandatory Requirements Checklist, the proposed change permits a note on the project drawings to meet the requirements instead of mandating graphical representation. In the proposed change, the term “where necessary” applies to cases where the placement of movement joints is identified by note alone without graphical depiction on the project drawings and there are elements in the design that would be adversely affected by improper movement joint placement. The proposal also changes the reference to the correct TMS 602 Article/Paragraph.

Background:

Many in TMS 402/602 feel that all movement joints should be graphically depicted on the project drawings. Multiple proposals and ballots have sought to mandate this in the Code however, there has not been adequate consensus among the members to allow passage. As such, we seek to incorporate the public comment while remaining consistent with the current content of the Code, Specification and Mandatory Requirement Checklist. After passage of ballot item 20-GR-217, Code Commentary for 1.2.1(h) now states that, “Movement joint locations are recommended to be included on the project drawings as they may provide greater clarity than notes.”

For reference, the Mandatory Requirements Checklist states in the Foreword the following:

F1. This Foreword is included for explanatory purposes only; it does not form a part of TMS 602.

F3. Checklists do not form a part of TMS 602.

As such, text added to the checklist under the heading of "Notes to Architect/Engineer," is considered commentary, and is not a code requirement.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code: NONE

Code Commentary: NONE

Specification and Specification Commentary: Article 3.3 is shown for user reference only and no changes are proposed. Changes to the Mandatory Requirements Checklist are proposed as shown.

3.3 — Masonry erection

3.3 E - *Embedded items and accessories* — Install embedded items and accessories as follows:

6. Install movement joints.

MANDATORY REQUIREMENTS CHECKLIST (Continued)		
TMS 602 Article/Paragraph		**Notes to the Architect/Engineer**
PART 3 — EXECUTION		
3.3 ~~D~~ E.2-4	Pipes and conduits	Specify sleeve sizes and spacing.
3.3 ~~D~~ E.5	Accessories	Specify accessories not indicated on the project drawings.
3.3 ~~D~~ E.6	Movement joints	Indicate type and location of movement joints on the project drawings and, where necessary, indicate where movement joints are not permitted in order to maintain structural design intent.

Subcommittee Vote:				
8 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	1 *Did not vote*

Subcommittee Comments: NONE

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-GR-096	
Technical Contact/Email: Charles Clark / cclark@bia.org	
Public Comment Number: 2022 Comment # 96	
Public Comment Response Based on TMS 402/602 Draft Dated	**11/5/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment: There is redundant language across Part 3 in regards to legally adopted load cases that should be consolidated in this section. In addition, IBC 2021 now adopts the ASCE 7 load combinations by reference, with the exception of retaining the alternate ASD load combinations. This change may not change how the legally adopted load combinations are referenced in TMS 402, but is brought to the committee's attention. Sections that should be looked at for potential consolidation with 4.1.2 include 9.1.2, 11.1.2, and 12.1.2.

It is anticipated that the individual chapters would still state whether ASD or SD load combinations should be used for a given chapter. Chapter 8 does not, but should, have a requirement to use allowable stress design load combinations.

Lastly, while Section 10.2.1 is already consistent with this comment, the wording of should be looked at for consistency across Part 3.

Response/Rationale:
This is the second proposal to attempt to address this public comment. It addresses the negative vote from the first proposal identified as 20-GR-096. It does so by using the term “calculated stresses” instead of “required strength” in the proposed text for Section 8.1.2 where the allowable stress design requirements are stipulated. It also addresses similar language existing in Section 10.4.3.1.

For reference, the current text of 4.1.2 and 10.2.1 is provided below:

4.1.2 Load provisions
Design loads shall be in accordance with the legally adopted building code of which this Code forms a part, with such live load reductions as are permitted in the legally adopted building code. In the absence of a legally adopted building code, or in the absence of design loads in the legally adopted building code, the load provisions of ASCE/SEI 7 shall be used, except as noted in this Code.

10.2.1 General
Members shall be designed to meet the strength provisions in this Chapter and checked for allowable stress level load requirements. The provisions of Section 10.4.3 shall apply for the calculation of nominal moment strength. Loading and load combinations shall be in accordance with the provisions of Section 4.1.2, except as noted in this Chapter.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

Note that text in brackets is for clarity only and is not intended as proposed text.

Add new Section 8.1.2, and renumber subsequent sections:

8.1.2 Calculated stresses [allowable stress design]

Calculated stresses shall be determined in accordance with the allowable stress design load combinations as designated in Section 4.1.2, except as noted in this Chapter.

Modify Section 9.1.2:

9.1.2 Required strength [strength design]

Required strength shall be determined in accordance with the strength design load combinations ~~of the legally adopted building code.~~ as designated in Section 4.1.2, except as noted in this Chapter. Members subject to compressive axial load shall be designed for the strength level moment accompanying the strength level axial load. The strength level moment, Mu, shall include the moment induced by relative lateral displacement.

Modify Section 10.4.3.1:

10. Strength requirements [prestressed masonry]

10.4.3.1 Required strength shall be determined in accordance with the strength ~~level~~ design load combinations ~~of the legally adopted building code.~~ as designated in Section 4.1.2, except as noted in this Chapter. ~~When the legally adopted building code does not provide strength level load combinations, structures and members shall be designed to resist the combination of loads specified in ASCE/SEI 7 for strength design.~~ Members subject to compressive axial load shall be designed for the strength level design moment and the accompanying strength level axial load. The strength level moment, Mu, shall include the moment induced by relative lateral displacement.

Modify Section 11.1.2:

11.1.2 Required strength [AAC masonry]

Required strength shall be determined in accordance with the strength design load combinations ~~of the legally adopted building code.~~ as designated in Section 4.1.2, except as noted in this Chapter. Members subject to compressive axial load shall be designed for the strength level moment accompanying the strength level axial load. The strength level moment, Mu, shall include the moment induced by relative lateral displacement.

Modify Section 12.1.2:

12.1.2 Required strength [masonry infills]

Required strength shall be determined in accordance with the strength design load combinations ~~of the legally adopted building code.~~ as designated in Section 4.1.2, except as noted in this Chapter. ~~When the legally adopted building code does not provide load combinations, structures and members shall be designed to resist the combination of loads specified in ASCE/SEI 7 for strength design.~~

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:									
8	*Affirmative*	0	*Affirmative w/ comment*	0	*Negative*	0	*Abstain*	1	*Did not vote*

Subcommittee Comments: NONE

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-GR-125	
Technical Contact/Email: Charles Clark / cclark@bia.org	
Public Comment Number: 2022 Comment # 125	
Public Comment Response Based on TMS 402/602 Draft Dated	**11/5/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment: Implies TMS 402 governs when conflicting with the legally adopted building code. IBC-18 102.4.1 "Where conflicts occur between provisions of this code and referenced codes and standards, the provisions of this code shall apply."

Response/Rationale:
This is the second proposal to attempt to address this public comment. It addresses the negative votes from the first proposal identified as 20-GR-125. It does so by adding an exception for cases when TMS 402 requirements conflict with the building code.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code: *Modify Section 1.1.2:*

1.1.2 Governing building code

This Code supplements the legally adopted building code and shall govern in matters pertaining to structural design and construction of masonry, except where in conflict with the building code. In areas without a legally adopted building code, this Code defines the minimum acceptable standards of design and construction practice.

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
8 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	1 *Did not vote*

Subcommittee Comments: NONE

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-GR-130	
Technical Contact/Email: Charles Clark / cclark@bia.org	
Public Comment Number: 2022 Comment # 130	
Public Comment Response Based on TMS 402/602 Draft Dated	**11/5/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment: Add "in design" before "to resist forces"

Response/Rationale:
This is the second proposal to attempt to address this public comment. It addresses all of the comments resulting from the first proposal identified as 20-GR-130 by adding "in design" to the definition. Thus, for cases where reinforcement is included in masonry but is not used by the design to resist forces, the element would be considered unreinforced masonry.

If 21-GR-130 and 21-GR-131 are adopted as proposed, the only difference between the definitions of "reinforced masonry" and "unreinforced masonry" will be whether the reinforcement is used or is not used in design to resist forces.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

2.2 — Definitions

Masonry, reinforced — Masonry in which reinforcement acting in conjunction with the masonry is used in design to resist forces.

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
8 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	1 *Did not vote*

Subcommittee Comments: NONE

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-GR-131	
Technical Contact/Email: Charles Clark / cclark@bia.org	
Public Comment Number: 2022 Comment # 131	
Public Comment Response Based on TMS 402/602 Draft Dated	**11/5/2021**

This ballot item proposes the following response to the Public Comment:

- ☐ ***Committee agrees with Public Comment, change is proposed***
- ☒ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***
- ☐ ***Committee disagrees with Public Comment and no changes are proposed***
- ☐ ***Committee unable to fully develop a response to Public Comment***
- ☐ ***Public Comment only requires a response, no change to document***

Public Comment: Add "in design" after "is neglected"

Response/Rationale:
This is the second proposal to attempt to address this public comment. It addresses all of the comments resulting from the first proposal identified as 20-GR-131 by modifying the definition of unreinforced masonry to more closely align with the definition of reinforced masonry. It does so by indicating that any reinforcement included in unreinforced masonry "is not used in design" to resist forces.

If 21-GR-130 and 21-GR-131 are adopted as proposed, the only difference between the definitions of "reinforced masonry" and "unreinforced masonry" will be whether the reinforcement is used or is not used in design to resist forces.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

2.2 — Definitions

Masonry, unreinforced — Masonry in which reinforcement, if present, is not used in design to resist forces. ~~the tensile resistance of masonry is taken into consideration and the resistance of reinforcing steel, if present, is neglected~~.

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
8 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	1 *Did not vote*

Subcommittee Comments: NONE

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-GR-135	
Technical Contact/Email: Charles Clark / cclark@bia.org	
Public Comment Number: 2022 Comment # 135	
Public Comment Response Based on TMS 402/602 Draft Dated	**10/26/2021**

This ballot item proposes the following response to the Public Comment:

☐ ***Committee agrees with Public Comment, change is proposed***

☒ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment: It is a long-time engineering practice to distribute lateral load by tributary area for low rise buildings with flexible diaphragms. It is more accurate for one- or two-story construction and as far as I know is still allowed by the IBC and ASCE 7. I suggest referencing ASCE 7. This is a complicated subject.

Response/Rationale:
This is the second proposal to attempt to address this public comment. This to It addresses the negative votes and comments from the first proposal identified as 20-GR-135. It does so by introducing the phrase "relative stiffness" in lieu of "rigidity" and by modifying the Code Commentary as appropriate.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

4.1.6 *Lateral load distribution*
Lateral loads shall be distributed to the structural system in accordance with relative ~~member~~ stiffnesses of structural members including horizontal diaphragms and shall comply with the requirements of this section.

Code Commentary:

4.1.6 *Lateral load distribution*
The design assumptions for masonry buildings include the distribution of forces to the ~~use of a~~ lateral-force-resisting system. ~~The distribution of lateral loads to the members of the lateral-force-resisting system is a function of the rigidities of the structural system and of the horizontal diaphragms.~~ Refer to ASCE/SEI 7 for more information about the methods used to distribute load to the lateral force-resisting system. The method of connection at intersecting walls and between walls and floor and roof diaphragms determines if the wall participates in the lateral-force-resisting system. Lateral loads from wind and seismic forces are normally considered to act in the direction of the principal axes of the structure. Lateral loads may cause forces in walls both perpendicular and parallel to the direction of the load. Horizontal torsion can be developed due to

eccentricity of the applied load with respect to the center of rigidity. The analysis of lateral load distribution should be in accordance with accepted engineering procedures.

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
8 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	1 *Did not vote*

Subcommittee Comments: NONE

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-GR-160	
Technical Contact/Email: Charles Clark / cclark@bia.org	
Public Comment Number: 2022 Comment # 160	
Public Comment Response Based on TMS 402/602 Draft Dated	**10/26/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit, but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment:
With the deletion of Section 3.2, commentary that stated, "Selection of units and bonding pattern should be coordinated to achieve requirements" was also deleted.

There was an important idea here for both designers and contractors that should be incorporated in the Code and Specification in order to reduce the risk of a disconnect between the grout space assumed by the designer and the grout space as constructed by the contractor. Accordingly, the following suggestion are made.

In TMS 402 Section 1.2.1, mandate that the designer specify the minimum grout space required by design. The commentary could include suggested minimum values for vertical cells of hollow units based on what was assumed in constructing the commentary tables in Section 6.1.3.2.5. For other situations, such as bond beams, the minimum grout space would presumably be based on the specified reinforcing area and Table 6.1.3.2.5.

In TMS 402 Section 1.2.1, require the designer to specify the bond pattern when reinforcing is to be placed in the cells of hollow units if the units are intended to be laid in other than one-half unit running bond.

In TMS 602 Article 2.3, address the need to supply hollow units that can achieve the minimum grout space required by the design drawings and which can also meet the construction requirements of Table 7.

In TMS 602 Article 3.3 A, when vertical reinforcing is used in hollow units the bond pattern should specifically be half unit running bond. The commentary could note that while stack bond would typically provide additional grout space, that there are additional requirements for masonry not-laid-in-running bond that the designer may not have considered if they have not specified a not-laid-in-running bond pattern.

Response/Rationale:
The committee agrees that the information in the deleted Commentary statement should be retained in the standard. Adding this information to TMS 402 Section 1.2.1 is appropriate. In developing this proposal, the GR Subcommittee has coordinated with RC Subcommittee to ensure that the proposed text is aligned with the current text on "gross grout space" in the Working Draft.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

1.2.1 Show or indicate all information required by TMS 402 on the project drawings or in the project specifications, including:

(a) Name and date of issue of Code and supplement to which the design conforms.
(b) Loads used for the design of masonry structures.
(c) Specified compressive strength of masonry at stated ages or stages of construction for which masonry is designed, for each part of the structure, except for masonry designed in accordance with Part 4.
(d) Size and location of structural members.
(f) Details of reinforcement, including the size, grade, type, lap splice length, and location of reinforcement.
(g) Reinforcement to be welded and welding requirements.
(h) Specified bond pattern and minimum gross grout space.
~~(h)~~ (i) Provision for dimensional changes resulting from elastic deformation, creep, shrinkage, temperature, and moisture.
~~(i)~~ (j) Size and permitted location of conduits, pipes, and sleeves.
~~(j)~~ (k) Masonry members in which mortar cement mortar or non-air-entrained cement-lime mortar is required.

Code Commentary: Renumber references to correspond with change to Code above.

1.2.1 This Code lists…

~~(h)~~ (i) Control joints…
~~(j)~~ (k) Under certain conditions, masonry cement mortar…

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
8 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	1 *Did not vote*

Subcommittee Comments: NONE

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-GR-169	
Technical Contact/Email: Charles Clark / cclark@bia.org	
Public Comment Number: 2022 Comment # 169	
Public Comment Response Based on TMS 402/602 Draft Dated	**10/26/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment: With the deletion of Section 3.2 the following commentary was deleted: "The TMS 602 Specification addresses material and construction requirements. It is an integral part of the Code in terms of minimum requirements relative to the composition, quality, storage, handling, and placement of materials for masonry structures."
It is unclear what provision this commentary was intended to address. Regardless, this is an important requirement for designers to be aware of and to require the compliance of contractors with. As a result, it is suggested that compliance with TMS 602 be listed as a required item on the contract documents in Section 1.2.1. The commentary that was deleted in Section 3.2 would then be restored at that location. Note that the commentary to the preface for TMS 602 makes a similar statement: "Part 1 of the Building Code Requirements for Masonry Structures (TMS 402) makes the Specification for Masonry Structures (TMS 602) an integral part of TMS 402."

Response/Rationale:
This is the second proposal to attempt to address this public comment. It addresses the negative votes and comments from the first proposal identified as 20-GR-169. It does so by adding a requirement in the Code for the project documents to reference TMS 602 and by restoring the Code Commentary language as requested by the public comment.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

1.2.1 Show or indicate all information required by TMS 402 on the project drawings or in the project specifications, including:

(k) Statement requiring that masonry construction conform to the requirements of TMS 602.

Code Commentary:

(k) The TMS 602 Specification addresses material and construction requirements. It is an integral part of the Code in terms of minimum requirements relative to the composition, quality, storage, handling, and placement of materials for masonry structures. The Specification also includes provisions requiring verification that construction achieves the quality specified. The construction must conform to these requirements in order for the Code provisions to be valid.

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
8 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	1 *Did not vote*

Subcommittee Comments: NONE

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-PI-149	
Technical Contact/Email: Charles Tucker/ctucker@fhu.edu	
Public Comment Number: 2022 Comment # 149	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

- ☐ ***Committee agrees with Public Comment, change is proposed***
- ☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***
- ☐ ***Committee disagrees with Public Comment and no changes are proposed***
- ☒ ***Committee unable to fully develop a response to Public Comment***
- ☐ ***Public Comment only requires a response, no change to document***

Public Comment:

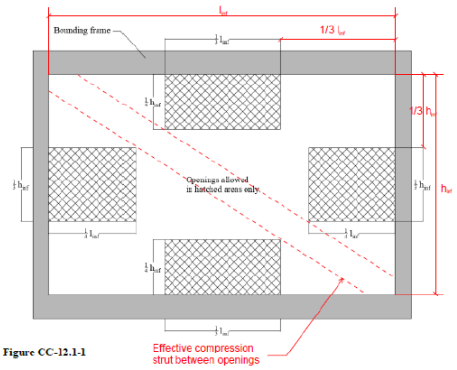
Public Comment # 149 read as follows:

Please consider adding provisions to allow small openings in masonry infills.

Response/Rationale:

Ballot 20-PI-149 proposed provisions to allow small openings in masonry infills. Five Affirmative with Comment votes were received, along with three Negative votes (provided below). This ballot is to find Dr. Abrams' negative vote Persuasive.

Item Number	Comment Type	Commenter	Comment	Comment File
20-PI-149 #149	Affirmative With Comment	Dr. Richard M. Bennett rmbennett@utk.edu	Editorially change 16" to 16 in. (406 mm).	
		Mr. Brian E. Trimble btrimble@imiweb.org	The metric equivalent must be added to new Section 12.1.5.1.3.	
		Mr. Charles B. Clark Jr. cclark@bia.org	In proposed Code Section 12.1.5.1.3, change "16"" to become "16 in. (406 mm)" In Code Commentary 12.1.5.1, new proposed paragraph, fourth line, change "...Sections 12.1.5.1..." to "...Section 12.1.5.1..."	
		Mr. David L. Pierson davep@arwengineers.com	For clarity, I suggest showing linf and hinf in the Figure CC-12.1-1.	
		Mr. John M. Hochwalt johnh@kpff.com	Please see attached for suggested enhancements to commentary figure CC-12.1-1.	Figure_CC-12.1-1_Hochwalt.pdf

			 Figure CC-12.1-1	
	Comment Non-Voting	Mr. Robert M. Chamra rchamra@buildingdx.com	Corresponding Member: Affirmative without comment.	
	Negative	Dr. Daniel P. Abrams d-abrams@illinois.edu	In Sec. 12.1.5.1 the terms “in any dimension” may be misconstrued to include the dimension normal to the infill plane, i.e. the infill thickness. If this wording is interpreted as such, then no openings of any size would be allowed in an infill thicker than 6 inches. I doubt if this is the intention. Perhaps it would be better to replace “in any dimension” with “width or length”. Figure CC-12.1-1 needs more clarification. The bounding frame should be shown as columns and beams for context (rather than shaded rectangles) and the figure should be designated as an elevation view. Dimensions should be given to locate the hatched areas. Dimension lines should follow standard format practice with arrows at their ends. Lines from the dimension lines should be drawn consistently (either hidden from bounding frame or shown, but not both).	
		Mr. Thomas Michael Corcoran tmcorcoran@comcast.net	Figure CC-12.1-1 requires more definition such as: 1. Define linf and hinf on the figure. 2. Define the white area of the figure. 3. Can the code 12.1.5.1 and 12.1.5.1.1 maximum opening size and cumulative area of openings requirements be shown on the figure? 4. Give the figure a title such as "generic (or common, universal, etc) infill wall elevation".	
		Ms. Heather A. Sustersic hsustersic@colbycoengineering.com	The proposed language appears to assume that the infill wall is designed to span vertically. What if the wall is designed to span horizontally? Also, please add that the openings should not interrupt bond beams, whether reinforcement is present or not.	

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown <u>underlined</u> and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

Code Commentary:

Specification: None

Specification Commentary: None

Subcommittee Vote:				
0 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments:
No official subcommittee vote was taken; however, email correspondence between subcommittee members indicates general agreement that one or more of the negative votes are persuasive.

THE FOLLOWING TEXT FROM 20-PI-149 IS ATTACHED FOR VOTER INFORMATION (NOT PART OF BALLOT)

Public Comment:

Public Comment # 149 read as follows:

Please consider adding provisions to allow small openings in masonry infills.

Response/Rationale:

The Committee agrees that the allowance of small openings in masonry infills is appropriate. Small openings have negligible impact on the strength or performance of the infill wall in which they are located as long as reinforcement, when required, is not displaced by the opening and the equivalent diagonal strut is not interrupted. A new Figure CC-12.1-1 provides a schematic of allowable opening locations. Research by Dawe and Seah (1989a) indicated the first crack load was essentially unaffected by even large openings within the infill wall, so the suggested limitations on opening size and location are conservative.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

12.1.5 *Limitations*
Partial infills and infills with openings larger than those permitted by Section 12.1.5.1 shall not be considered as part of the lateral force-resisting system. Their effect on the bounding frame, however, shall be considered.

12.1.5.1 *Maximum opening size* – Openings in infills shall not exceed 6 in. (152 mm) in any dimension at the face of the wall and shall not interrupt reinforcement required by Section 7.4.

12.1.5.1.1 *Maximum cumulative area of openings* – The cumulative area of openings shall not exceed 144 in.^{2} (0.093 m^2) in any 10 ft^2 (0.93 m^2) of wall surface area.

12.1.5.1.2 *Location of openings* – Openings adjacent to the bounding columns shall be permitted only in the middle third of the infill height and the exterior quarter of the infill length. Openings adjacent to the bounding beam or slab shall be permitted only in the middle third of the infill length and the exterior quarter of the infill height.

12.1.5.1.3 *Spacing of openings* – Clear spacing between openings shall not be less than 16".

Code Commentary:

12.1.5.1 *Limitations*

Structures with partial-height infills have generally performed very poorly during seismic events. Partial-height infills create short columns, which attract additional load due to their increased stiffness. This has led to premature column failure. Concrete columns bounding partial-height infills are particularly vulnerable to shear failure (Chiou et al, 1999).

Small openings have negligible impact on the strength or performance of the infill wall in which they are located as long as reinforcement, when required, is not displaced by the opening and the equivalent diagonal strut is not interrupted. See Figure CC-12.1-1 for a schematic of allowable opening locations. Openings in excess of those permitted by Sections 12.1.5.1 have the potential to impact structural performance of the equivalent diagonal strut. Research by Dawe and Seah (1989a) indicated the first crack load was essentially unaffected by even large openings within the infill wall, so the limitations on opening size and location are conservative. Infill walls with excessive openings are required to be designed as non-participating infills per Section 12.2. For the purposes of this Chapter, the term openings includes penetrations.

12.1.5.1.2 *Location of openings* – The limitations of Section 12.1.5.1.2 are sufficient for typical strut widths; however, the designer should verify an opening does not interrupt the equivalent diagonal strut width.

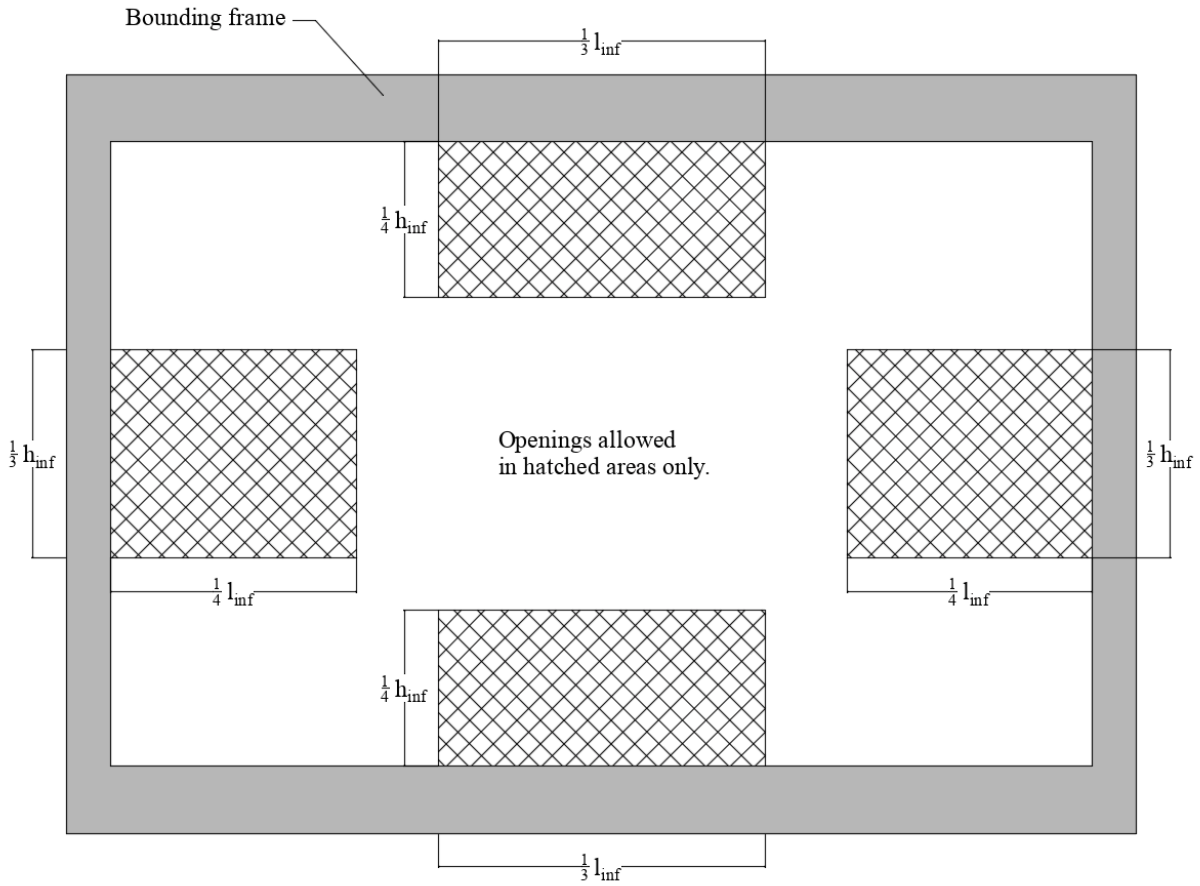


Figure CC-12.1-1

Specification: None

Specification Commentary: None

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-PR-001	
Technical Contact/Email: Arturo E. Schultz, arturo.schultz@utsa.edu	
Public Comment Number: 2022 Comment # 30	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☐ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☒ ***Public Comment only requires a response, no change to document***

Public Comment #30:

The first sentence of Section 10.1.5 states "Masonry beams and lintels shall have a uniform width and be fully grouted or solid, and reinforced to distribute anchorage forces." It does not appear that the code addresses how the designer should determine what reinforcing is required for the distribution of anchorage forces. Since this anchorage reinforcement is a code requirement, the code should include provisions for this reinforcement.

Response/Rationale:

The PR Subcommittee thanks the commenter and agrees that additional provisions and guidance is appropriate regarding the distribution of anchorage forces and, under specific conditions, the requirement of anchorage reinforcement. Anchorage provisions were drafted as item 19-PR-030 in Main Committee Ballot 19. It received two negative votes, including one by John Hochwalt which was found to be persuasive. The PR Subcommittee is working to improve the ballot item but has not reached consensus over some aspects of this Public Comment. This matter will be taken up as new business in the next code cycle.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code: NONE

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
7 *Affirmative*	2 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments:

Ghosh: Is it necessary to mention the life safety issue. I am not sure if it is not a life safety issue.

Scott: The wording regarding the PT force being low is a very subjective phrase. Is there another reason we don't think this is a life safety item?

Subcommittee Resolution: The last sentence, which mention of life safety, was removed.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-PR-002	
Technical Contact/Email: Arturo E. Schultz, arturo.schultz@utsa.edu	
Public Comment Number: 2022 Comment # 175	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment #175:

The section of commentary presents expected losses for "typical wall applications." It is unclear what would constitute a typical wall application. It is our understanding that the intent of the commentary is that a typical wall application would be one in which a high strength steel would be prestressed to near the maximum limits permitted by code. The commentary should be revised to clarify this intent and to warn the user that losses may be considerably higher for applications with lower prestressing strains.

Response/Rationale:

The PR Subcommittee thanks the commenter agrees that what it intended by the expression “typical wall application” needs to described in a more detailed manner. This ballot item modifies Commentary section 10.3.4 to include the description. However, the Subcommittee notes that typical prestressed masonry walls to date have been reinforced with relatively low amounts of intermediate grade steel.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code: NONE

Code Commentary: The following modification is proposed to Code Commentary section 10.3.4.

The Committee believes these ranges provide reasonable estimates for typical wall applications to date, unless calculations, experience, or construction techniques indicate different losses are expected. To date, prestressed walls have been built using ASTM C90 block with relatively small amounts of intermediate grade reinforcement, such as A722 Grade 120 bar, which is prestressed to magnitudes near the maximum limits permitted by code. Losses for prestressing steels with a yield strength below 100 ksi (690 MPa) can be considerably higher than the ranges suggested above (TMS Responds, 2021).

References: The following reference should be added to Chapter 10.

TMS Responds, Vol. 19 (1), (2021), "Calculating Losses for High and Low Strength Steels in Prestressed Masonry", The Masonry Society, www.masonrysociety.org.

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
8 *Affirmative*	1 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments:

Woodham: "Losses for prestressing steels with a yield strength below 100 ksi (690 MPa) can be considerably higher."

Subcommittee Resolution: The proposed Code Commentary change was modified to address Woodham's comment.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-PR-003	
Technical Contact/Email: Arturo E. Schultz, arturo.schultz@utsa.edu	
Public Comment Number: 2022 Comment # 179	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment #179:

With the revised phi factors for tension controlled and compression controlled sections in Section 9.1.4.4, this commentary is no longer correct and should be revised.

Response/Rationale:

The PR Subcommittee thanks the commenter and agrees that additional information is needed in the Code Commentary section 10.4.3.2 in light of the definitions of tension controlled and compression controlled sections in Code section 9.1.4.4. This ballot item modifies Code Commentary section 10.4.3.2.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code: NONE

Code Commentary: The following modification is proposed to Code Commentary section 10.4.3.2.

The same value for the strength reduction factor that is used for tension-controlled sections in flexure (ϕ = 0.8) is used for axial load in prestressed masonry. Axial loads from prestressing will be sufficiently low to ensure ductile behavior if the a/x_t limits in Tables 10.5.3 and 10.6.3 are satisfied. ~~This is the same procedure that is used for reinforced masonry in Chapter 9, where a single value for the strength-reduction factor, ϕ, is used for flexure and axial load.~~

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
7 *Affirmative*	2 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments:

Biggs: "This should have been presented by the originators of change for tension versus compression controlled when that ballot was put forward. It demonstrates the challenge of working in silos and not evaluating the effect on other chapters."

Nahlawi: Could we define what "sufficiently low" means? Could a value be provided; i.e. $0.1P_n$?

Subcommittee Resolution: The PR Subcommittee appreciates the background information provided by Biggs, and modified the proposed change to include a definition of what it meant by "sufficiently low" in terms of quantities defined in Chapter 10 (maximum limits on a/x_t).

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-PR-004	
Technical Contact/Email: Arturo E. Schultz, arturo.schultz@utsa.edu	
Public Comment Number: 2022 Comment # 180, 181 and 189	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment #180, 181 and 189:

Public Comment 180:
In equation 10-1 should the terms be d_{ps} instead of d?

Public Comment 181:
The ratio a/d does not seem right, especially given that there may not be bonded reinforcing. Should this be a/d_{ps}? a/x_t?

Public Comment 189:
Now that "d_{ps}" has been introduced, should "d_{ps}" be used in this section instead of "d"?

Response/Rationale:

The PR Subcommittee thanks the commenters and agrees with Public Comments 180, 181 and 189 that there instances of d in Chapter 10 where d_{ps} should be used in its place. Because the three Public Comments address the same issue, instances where d is shown instead of another effective depth measure, a single Response is provided here as well as a proposed change that addresses all instances where d should be replaced with another effective depth measure. A third definition for effective depth, x_t, already exists in TMS 402 and is used as well. The depth x_t is the distance from the compression face to the centroid of the resultant tension force from the combination of prestressed and non-prestressed reinforcement at nominal capacity. The proposed change in this ballot modifies Code sections 10.4, 10.5 and 10.6.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code: The following modifications are proposed for Code sections 10.4.3.3.2, 10.5.1.2, 10.5.1.5, 10.5.2, 10.5.3, and 10.6.3.

In section 10.4.3.3.2:

~~$$f_{ps} = f_{se} + \left[\frac{0.03\left(\frac{E_{ps} d}{\ell_p}\right)\left(1 - 1.56\frac{A_{ps} f_{se} + P_u/\phi}{f'_m b d}\right)}{1 - 0.0468\left(\frac{E_{ps} A_{ps}}{f'_m b \ell_p}\right)} \right]$$~~

$$f_{ps} = f_{se} + \left[\frac{0.03\left(\frac{E_{ps} d_{ps}}{\ell_p}\right)\left(1 - 1.56\frac{A_{ps} f_{se} + P_u/\phi}{f'_m b x_t}\right)}{1 - 0.0468\left(\frac{E_{ps} A_{ps}}{f'_m b \ell_p}\right)} \right] \quad \text{(Equation 10-1)}$$

In section 10.5.1.2:

~~$$M_n = \left(f_{ps} A_{ps} + f_y A_s + P_u/\phi\right)\left(d - \frac{a}{2}\right)$$~~

$$M_n = \left(f_{ps} A_{ps}\right)\left(d_{ps} - \frac{a}{2}\right) + \left(f_y A_s\right)\left(d - \frac{a}{2}\right) + \left(P_u/\phi\right)\left(x_t - \frac{a}{2}\right) \quad \text{(Equation 10-3)}$$

In section 10.5.1.5:

10.5.1.5 ~~The distance *d* shall be calculated as the actual distance from the centerline of the tendon to the compression face of the member.~~ For walls with laterally unrestrained prestressing tendons and loaded out of plane, ~~*d*~~ d_{ps} shall not exceed the face-shell thickness plus one-half the tendon diameter plus 0.375 in. (9.5 mm).

In section 10.5.2:

10.5.2 *Tendons or mild reinforcement not centered*
When tendons or reinforcement are not placed in the center of the wall, *d* and d_{ps} shall be calculated in each direction for out-of-plane bending.

In section 10.5.3:

10.5.3 The ratio ~~*a/d*~~ a/x_t shall not exceed the value in Table 10.5.3.

Table 10.5.3: Limits for ~~*a/d*~~ a/x_t in Prestressed Masonry Walls

Type of Wall	Masonry Unit Material	
	Concrete	Clay
Walls subject to out-of-plane loading, ordinary shear walls	0.36	0.38
Intermediate shear walls	0.23	0.29
Special shear walls	0.19	0.24

In section 10.6.3:

10.6.3 Ratio of ~~*a/d*~~ a/x_t
The ratio ~~*a/d*~~ a/x_t shall not exceed the value in Table 10.6.3.

Table 10.6.3: Limits for ~~*a/d*~~ a/x_t in Prestressed Masonry Beams and Lintels

Type of Member	Masonry Unit Material	
	Concrete	Clay
Beams and lintels	0.36	0.38

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
8 *Affirmative*	1 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments:

Biggs: "In the following proposed table changes, there appear to be some missing/typo items."

Subcommittee Resolution: The Subcommittee made the corrections identified by Biggs.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-PR-005	
Technical Contact/Email: Arturo E. Schultz, arturo.schultz@utsa.edu	
Public Comment Number: 2022 Comment # 187	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment #187:

This paragraph of commentary appears to be the only place that verification of material strength prior to transfer of the prestressing forces is addressed.

Given the hazard of transferring prestressing forces to materials with inadequate strength, there should be requirements in TMS 602, including in the QA table, for the verification of material strength prior to force transfer.

The reference to reliance on a past history of strength gain should be deleted. There is sufficient variation in the strength gain of masonry materials that this could result in unsafe conditions. Prestressed concrete manufacturers, for example, take cylinders and test them prior to force transfer.

If concrete end blocks are being used f'_{ci} needs to be verified as well as f'_{mi}. There may also be a role for testing the grout strength, f'_{gi}, when concrete end blocks are not used as the grout will experience the highest stresses at the anchorages.

Response/Rationale:

The PR Subcommittee agrees the commenter that the determination of f'_{mi} needs to be addressed. This ballot proposes to modify Code Commentary section 10.2.2 and Specification section 1.6A to address f'_{mi}. If concrete end blocks are used, assessment of concrete compressive strength immediately before the transfer of prestress should be done according to concrete design specifications (ACI 318-19). Determination of grout strength is not required if f'_m does not exceed 2,000 psi (TMS 602 Specification section 2.2B).

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code: NONE

Code Commentary: The following modification is proposed for section 10.2.2

A masonry wall is typically prestressed prior to 28 days after construction, sometimes within 24 hours after construction. The specified compressive strength of the masonry at the time of prestressing (f'_{mi}) is used to determine allowable prestressing levels. This strength will likely be a fraction of the 28-day specified compressive strength. Assessment of masonry compressive strength immediately before the transfer of prestress should be by testing of masonry prisms ~~or by a record of strength gain over time of masonry prisms constructed of similar masonry units, mortar, and grout, when subjected to similar curing conditions~~. If concrete end blocks are used, assessment of concrete compressive strength immediately before the transfer of prestress should be done according to concrete design specifications (ACI 318).

Specification: The following modification is proposed for section 1.6A

Table 3: Minimum Verification Requirements

Minimum Verification	Required for Quality Assurance[(a)]			Reference for Criteria
	Level 1	Level 2	Level 3	TMS 602
Prior to construction, verification of compliance of submittals.	R	R	R	Art. 1.5
Prior to construction, verification of f'_m and f'_{AAC}, except where specifically exempted by the Code.	NR	R	R	Art. 1.4 B
During construction, verification of Slump flow and Visual Stability Index (VSI) when self-consolidating grout is delivered to the project site.	NR	R	R	Art. 1.5 & 1.6.3
During construction, verification of f'_m , f'_{mi} and f'_{AAC} for every 5,000 sq. ft. (465 sq. m).	NR	NR	R	Art. 1.4 B
During construction, verification of proportions of materials as delivered to the project site for premixed or preblended mortar, prestressing grout, and grout other than self-consolidating grout.	NR	NR	R	Art. 1.4 B

(a) R=Required, NR=Not Required

Specification Commentary: NONE

Subcommittee Vote:				
8 *Affirmative*	1 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments:

Biggs: The ballot is incomplete. The commenter also point out that neither the end block concrete strength nor the grout strength are being verified.

Subcommittee Response: The proposed Subcommittee Response was modified to include comments on both concrete strength and grout strength.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-PR-006	
Technical Contact/Email: Arturo E. Schultz, arturo.schultz@utsa.edu	
Public Comment Number: 2022 Comment # 188	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment #188:

This requirement seems applicable to walls only. How is this intended to be applied to beams?

Response/Rationale:

The PR Subcommittee thanks the commenter and agrees that clarification is needed in view of the addition of prestressed masonry beams and lintels to Chapter 10. This ballot clarifies the applicability to the various types of prestressed members .

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code: The following changes are proposed to sections 10.1.3 and 10.1.4

10.1.3 Masonry in walls shall be laid in running bond unless a bond beam or other technique is used to distribute anchorage forces.

10.1.4 For masonry ~~members~~ walls, beams and lintels, the prestressing force shall be added to load combinations, except as modified by Section 10.4.2.

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
8 *Affirmative*	1 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments:

Biggs: I disagree with the need for the proposed change in 10.1.3; it appears to be redundant. This was previously considered by the subcommittee. Masonry is adequate without the term "in walls". The end anchorage of beams and lintels already addresses the fact that the horizontal post-tensioning is perpendicular to the running bond of the masonry. Commentary 10.1.5 clearly covers this.

The same goes for changes to 10.1.4. "Members" covers wall, beams and lintels. Are we to add slabs, columns, and pilasters to the list should the chapter grow to include them? The Commentary to 10.1.1 clearly indicates columns are not included in the chapter yet.

Subcommittee Response: The change to Code section 10.1.3 is needed because Code section 10.1.5 indicates that beams and lintels have to be solid. Thus, there is conflict between the two sections unless section 10.1.3 is limited to walls only. The changes to Code section 10.1.4 are deemed to emphasize in a clear manner the range of members for which it is applicable.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-PR-007	
Technical Contact/Email: Arturo E. Schultz, arturo.schultz@utsa.edu	
Public Comment Number: 2022 Comment # 191	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☐ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☒ ***Public Comment only requires a response, no change to document***

Public Comment #191:

It is suggested to delete the paragraph of commentary about the effects of sequential stressing because the effects are small, and the complexity of the analysis required to consider those effects is not warranted. For example, Note that Woodham and Hamilton (2003) only showed a 2% to 3% loss due to stressing sequence with closely spaced prestressing steel (2' on center). For additional context, stressing sequence is not considered in prestressed concrete design.

Response/Rationale:

The Subcommittee thanks the commenter, but disagrees with the Public Comment regarding possible magnitudes of prestress changes under sequential stressing. Experimental data is scarce for the effect of stressing sequence on prestressed masonry walls, and it is nonexistent for prestressed masonry beams and lintels. The influence of bed joints parallel to the tendons in the latter has the potential for performance that differs from that for concrete beams. Moreover, this comment is offered as a suggestion in the Commentary and not a requirement in the Code. Consequently, no change is warranted until that time when experimental data indicates otherwise.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code: NONE

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
7 *Affirmative*	1 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	1 *Did not vote*

Subcommittee Comments:

Biggs: This might be true with walls, but is it true for beams and lintels? I haven't seen that research. I'd suggest keeping

Subcommittee Resolution: The item was rewritten in light of Biggs' comments, and re-balloted within the Subcommittee.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee:	**Main Committee**	**Ballot #:**	**21**
Item #:	**21-RC-001**		
Technical Contact/Email:	Heather Sustersic, hsustersic@colbycoengineering.com		
Draft Document Dated:	**1/29/2022**		
Reballot of Main Committee Item No.:	N/A	**Response to TAC Comment No.:** N/A	**Response to Public Comment No.:** 045

Reference ***(Choose from Drop-Down Menu)***	**Section/Article**
TMS 402 Code Section	-
TMS 402 Commentary Section	6.1.8.1
TMS 602 Specification Article	-
TMS 602 Commentary Article	-

Rationale: *(Rationale is explanatory and not part of the proposed revision)*
Main committee ballot item 20-RC-002, addressing public comment #45, received several affirmative comments and one negative vote. The affirmative comments received suggest improvements to the wording of the added commentary language to sections 6.1.10.1.3 and 6.1.10.3 as well as clarification of the dimension 'd' shown in the figure.

The negative vote from Biggs is as follows:

I'm more confused by the ballot than what exists. I suggest no change.

While the subcommittee agrees that the proposed commentary language and figure could be improved further, the subcommittee respectfully disagrees that the proposed figure changes in response to the public comment introduce confusion. This ballot item, therefore, proposes to find the negative vote from David Biggs non-persuasive. A separate ballot item proposing improved commentary language in response to the affirmative comments follows as ballot 21-RC-002.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Affirmative votes on this ballot are in support of finding the negative vote non-persuasive.

Code: NONE
Code Commentary: NONE
Specification: NONE
Specification Commentary: NONE
Mandatory Requirements Checklist: NONE
Optional Requirements Checklist: NONE

Subcommittee Vote:									
11	*Affirmative*	0	*Affirmative w/ comment*	0	*Negative*	0	*Abstain*	3	*Did not vote*

Subcommittee Comments:

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-RC-002 PC45	
Technical Contact/Email: Heather Sustersic, hsustersic@colbycoengineering.com	
Public Comment Number: 2022 Comment # 45	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment:

Consider balloting a change to Figure CC-6.1-8 to clarify that the lap shown is not a lap splice but rather the extension of negative moment reinforcement required by Section 6.1.10.

Response/Rationale:

Main committee ballot item 20-RC-002, addressing public comment #45, received several affirmative comments and one negative vote. This ballot is contingent upon the passage of ballot 21-RC-001 which moves to find the negative vote non-persuasive. As such, all proposed changes are taken with respect to 20-RC-002.

Two affirmative comments related to the graphical depiction of distance "d" on bars 'a' and bars 'b.' It is important to note that Figure CC-6.1-8 is titled "Development of flexural reinforcement in a continuous wall with **centered** reinforcement" (emphasis added). As such, the subcommittee agrees that it is not necessary to dimension "d" multiple times. One "d" dimension is proposed to be deleted from bars 'a' and bars 'b'. The word "centered" is proposed to be underlined for emphasis.

The remaining affirmative comments related to the addition of commentary language in sections 6.1.10.1.3 and 6.1.10.3. This ballot incorporates the suggested wording proposed by Hochwalt with a cross-reference to Section 6.1.7 added for clarity.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Proposed changes are underlined in red or clouded in figure CC6.1.8 as shown below.

Code:

None

Code Commentary:

6.1.10.1.2 Critical sections for a typical continuous beam are indicated in Figure CC-6.1-7. Critical sections for a multi-span wall are indicated in Figure CC-6.1-8.

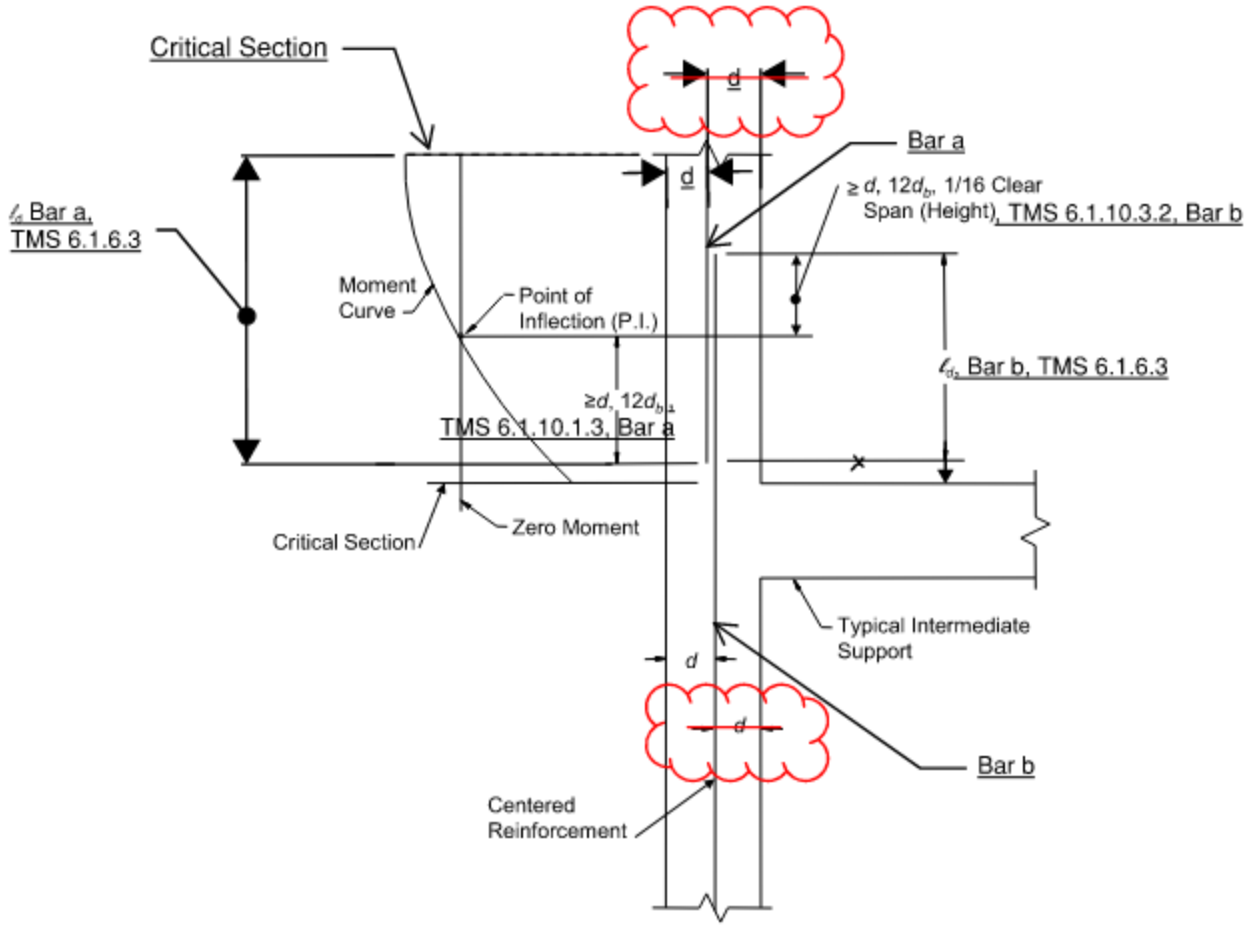


Figure CC-6.1-8 — Development of flexural reinforcement in a continuous wall with centered reinforcement

6.1.10.1.3 The moment diagrams customarily used in design are approximate. Some shifting of the location of maximum moments may occur due to changes in loading, settlement of supports, lateral loads, or other causes. A diagonal tension crack in a flexural member without stirrups may shift the location of the calculated tensile stress approximately a distance d toward a point of zero moment. When stirrups are provided, this effect is less severe, although still present.

To provide for shifts in the location of maximum moments, this Code requires the extension of reinforcement a distance *d* or 12d_b beyond the point at which it is theoretically no longer required to resist flexure, except as noted. ~~When terminal development lengths for positive and negative reinforcement occur coincidentally, the total lap length created need not exceed that required by Section 6.1.7.~~ In lieu of providing the development lengths and bar extensions shown in Figure CC-6.1-8, the reinforcing may be made continuous with a splice as defined in Section 6.1.7.

Cutoff points of bars or deformed wires to meet this requirement are illustrated in Figure CC-6.1-7.

When bars or deformed wires of different sizes are used, the extension should be in accordance with the diameter of reinforcement being terminated. A bar or deformed wire bent to the far face of a beam and continued there may logically be considered effective in satisfying this section, to the point where the bar or deformed wire crosses the middepth of the member.

6.1.10.3 *Development of negative moment reinforcement* — Negative reinforcement must be properly anchored beyond the support faces by extending the reinforcement ℓ_d into the support or by anchoring of the reinforcement with a standard hook or suitable mechanical device.

Section 6.1.10.3.2 provides for possible shifting of the moment diagram at a point of inflection, as discussed under Commentary Section 6.1.10.1.3. This requirement may exceed that of Section 6.1.10.1.3 and the more restrictive governs. ~~When terminal development lengths for positive and negative reinforcement occur coincidentally, the total lap length created need not exceed that required by Section 6.1.7.~~ In lieu of providing the development lengths and bar extensions shown in Figure CC-6.1-8, the reinforcing may be made continuous with an appropriate splice.

Specification:

None

Specification Commentary:

None

Subcommittee Vote:									
10	*Affirmative*	1	*Affirmative w/ comment*	0	*Negative*	0	*Abstain*	3	*Did not vote*

Subcommittee Comments:

The affirmative comment pointed out that:
1) the bars passing the intermediate support are negative moment reinforcement while bars above/below are positive moment reinforcement, despite being centered with the same 'd', but
2) the figure relates to bar extensions past the point of inflection, rather than identifies negative or positive moment reinforcement due to continuity.

Therefore, no changes were requested or resulted from the affirmative comment.

A corresponding member comment suggested removing the underline emphasis on the word "centered" from the commentary title. Because this figure is unique to walls with centered reinforcement, and because previous ballot comments suggested general confusion over how this figure relates to walls with two curtains of vertical reinforcement, the emphasis remains as balloted to the subcommittee.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-RC-003 PC185	
Technical Contact/Email:	Heather Sustersic, hsustersic@colbycoengineering.com Dick Bennett, rbennet2@utk.edu
Public Comment Number:	2022 Comment # 185
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

- ☐ ***Committee agrees with Public Comment, change is proposed***
- ☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***
- ☒ ***Committee disagrees with Public Comment and no changes are proposed***
- ☐ ***Committee unable to fully develop a response to Public Comment***
- ☐ ***Public Comment only requires a response, no change to document***

Public Comment:

Since GFRP bars are more sensitive to elevated temperatures, I recommend either including limitations for in-service temperatures or introducing strength reduction factors for elevated temperature service.

Response/Rationale:

The concern with elevated temperature is already addressed in commentary to D.1.1 which states:

> *GFRP reinforcing bars are generally more sensitive to elevated temperatures than steel reinforcement, which can influence the fire-resistance of GFRP reinforced masonry members. At a temperature close to the glass transition temperature, T_g, the mechanical properties of resin are reduced, resulting in reduced bond strength between the resin and the fibers. The value of T_g depends on the type of resin, but is typically in the range of 200 to 250 °F (93 to 120 °C) for resins used in GFRP bars.*

A structure in which this would be a concern would be a structure with an operating temperature at or above the boiling point of water. This would be a specialized design. We do not address other specialized designs, such as in highly corrosive environments or in high electric fields. Also, because the glass transition temperature varies with the resin selected, placing an absolute limit on in-service temperature in the Code is inappropriate.

As stated in previous ballot responses, fire-ratings and permissible construction for fire-rated walls are beyond the scope of TMS 402. Although it may be appropriate for other codes to put limitations on the use of GFRP reinforcing in fire-rated walls, the complete disallowing is not appropriate. The walls could be designed using the Performance Based Design Procedures for Fire Effects in Appendix E of ASCE 7.

Therefore, no change to the code or commentary is warranted.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

None

Code Commentary:

None

Specification:

None

Specification Commentary:

None

Subcommittee Vote:									
10	*Affirmative*	1	*Affirmative w/ comment*	0	*Negative*	0	*Abstain*	3	*Did not vote*

Subcommittee Comments:

The affirmative comment stated:

I agree with the rationale and the response, and I think that the Commentary well addresses the concern for elevated temperature performance concerns for users to consider.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-RC-004	
Technical Contact/Email:	Scott Walkowicz / scott@walkowiczce.com, Adam Hutchinson / ahutchinson@nwcma.org
Public Comment Number:	2022 Comment # 211
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Response/Rationale:

Main committee ballot item 20-RC-017 addressed public comment #211 by adding figures and commentary language to include clay units in the explanation of gross grout space area. Ballot item 20-RC-017 passed at Main with no negative votes, but received several affirmative comments suggesting additional improvements for clarity. This ballot proposes to incorporate those suggestions.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

None

Code Commentary:

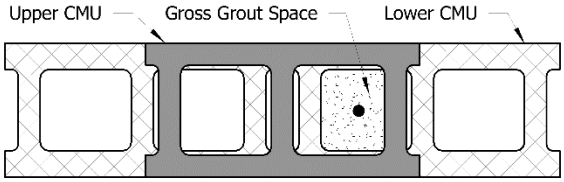
6.1.3.2.5 The limitations on maximum reinforcement percentage are based on the gross grout space presented by the cell, bond beam course, collar joint, or AAC masonry core. These limitations are in contrast to the requirements for grout placement in TMS 602 Table 7, which are based on the net grout space per Footnote 3 and TMS 602 Figure SC-21. The limitations of Section 6.1.3.2.5 are intended to avoid overreinforcing, while the limitations of TMS 602 Article 3.5C are intended to prevent problems with grout consolidation. The alternative provisions presented in Table 6.1.3.2.5.1 and Table 6.1.3.2.5.2 provide a simplified method of determining the maximum vertical reinforcement permitted by TMS 402 when designing vertically reinforced two-celled hollow concrete masonry and hollow clay masonry even though the dimensions of the unit cross-section are unknown before the units have been ordered by the contractor. Because these provisions are simplified, they are also conservative. Designers who know the cross-sectional dimensions of the units to be used on the project may be able to specify greater amounts of reinforcement than those shown in these Tables, especially for units greater than 6-in. (152 mm) in thickness. The percentages in these Tables were correlated to the values in Table 6.1.3.2.5 and

are based on “per 8-in. (203 mm) length” (per cell or core for two-celled units), with a footnote to address nominal 12-in. (305 mm) long clay units that have a 6-in. (152 mm) length per core or cell. Table 6.1.3.2.5.1 applies to units laid in one-half running bond (units overlap 50% of their length) and Table 6.1.3.2.5.2 applies to units laid in stack bond (unit overlap 100% of their length). Figure CC-6.1-1 illustrates two-celled flanged units, jamb units, and open-end units laid in one-half running bond for typical CMU and clay units.

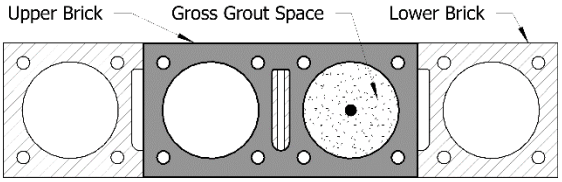
Concrete and clay masonry unit configurations can vary regionally and between manufacturers due to local production preferences. Consult producers local to the project to develop expected unit geometric parameters prior to calculating gross grout space. Other detailing aspects such as corbeling and varied unit overlap can also affect the available gross grout space. Include sufficient notes and/or details to illustrate necessary unit geometry and unit placement limits for compliance with the design basis. Refer to Figure CC-6.1-1 for illustrations of several unit possibilities in one-half running bond pattern. Other bond patterns and unit alignments may require special consideration in the calculation of ~~should be considered when calculating the~~ gross grout space.

Section 6.1.3.2.5, and Table 6.1.3.2.5, have been developed for use with a calculated gross grout space area and that space is the gross area available for grout based solely on the unit geometric properties and placement (bond, alignment, corbeling, etc.). Note that concrete masonry units typically include a taper for mold removal and, therefore, are thicker at their tops and the maximum thickness should be used when calculating the gross grout space. Structural clay units are typically extruded and maintain constant wall thickness throughout their depth. The effects of other items such as mortar extrusions, vertical and horizontal bars, etc., should not be included in the calculation of gross grout space.

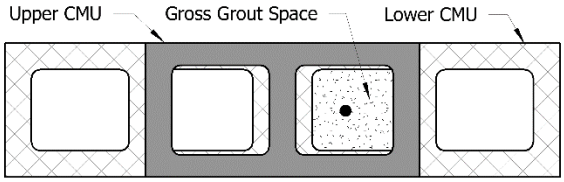
Table CC-6.1.3.2.5.1 shows the maximum size and quantity of vertical reinforcement permitted by Sections 6.1.3.2.5, 6.1.3.2.5.1, and 6.1.3.2.2 for two-celled masonry units laid in one-half running bond. Table CC-6.1.3.2.5.2 shows the maximum size and quantity of vertical reinforcement permitted by Sections 6.1.3.2.5, 6.1.3.2.5.2, and 6.1.3.2.2 for two-celled masonry units laid in stack bond. Tables CC-6.1.3.2.5.1 and CC-6.1.3.2.5.2 do not include nominal unit thicknesses less than 6-in. (152 mm) as there are no commercially available two-celled units with an 8-in. (203 mm) module. Table CC-6.1.3.2.5.3 shows the maximum size and quantity of vertical reinforcement permitted by Sections 6.1.3.2.4, 6.1.3.2.5.1, and 6.1.3.4.4 for two-celled, 12-in. (305 mm) long clay masonry units. The maximum reinforcement listed in both tables may be doubled at lap splice locations.



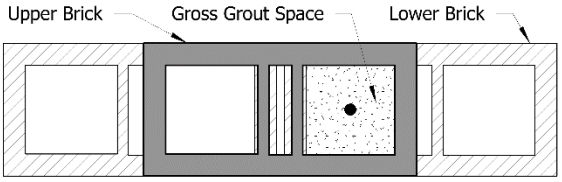
(a) Flanged units laid in one-half running bond



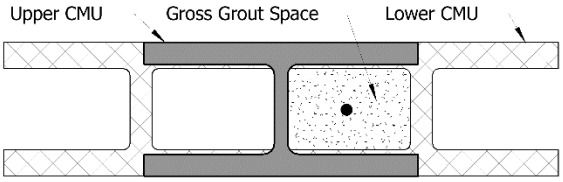
(d) Circular core units laid in one-half running bond



(b) Jamb units laid in one-half running bond



(e) Rectangular core units laid in one-half running bond



(c) Open-end units laid in one-half running bond

Figure CC-6.1-1 – Two-celled flanged units, jamb units, and open-end units laid in one-half running bond for concrete masonry units (a), (b), (c), and clay units (d), (e)

Specification:

None.

Specification Commentary:

None.

Subcommittee Vote:				
9 *Affirmative*	1 *Affirmative w/ comment*	0 *Negative*	1 *Abstain*	3 *Did not vote*

Subcommittee Comments:
The affirmative comment related to an error in the ballot label text – this has been corrected.

One affirmative comment to 20-RC-017 was not addressed in this ballot due to a related ballot in the general requirements subcommittee. RC subcommittee members were invited to comment on 21-GR-160, related to the addition of a requirement for showing bond pattern, unit geometry, and minimum gross grout space on the contract documents.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-RC-005	
Technical Contact/Email: John M. Hochwalt / john.hochwalt@kpff.com	
Public Comment Number: 2022 Comment # 37	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

- ☐ ***Committee agrees with Public Comment, change is proposed***
- ☒ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***
- ☐ ***Committee disagrees with Public Comment and no changes are proposed***
- ☐ ***Committee unable to fully develop a response to Public Comment***
- ☐ ***Public Comment only requires a response, no change to document***

Public Comment:

Public Comment 37 pointed some potential issues with the treatment of stainless steel joint reinforcement in the code and specification.

Response/Rationale:

The substance of this public comment has been addressed by ballots 19-RC-003, 20-DE-037 and 20-SL-019. In addition ballot 20-RC-003 cleaned up the provisions passed in 19-RC-003, but received two further affirmative with comment votes suggesting additional improvements. Those comments were as follows:

Bennett Comment

> *Is there still an issue here? I could interpret the "or" in 2.4 D.1 as meaning if I use stainless steel wire I don't have to meet any of the requirements of A951. I think the intent is just to allow the stainless steel material, but all the other requirements of A951, such as knurling, weld shear strength, dimensions and tolerances, etc still apply. I don't know that I have the best solution but perhaps something along the lines of:*
>
> *2.4 D.1 Conforms to ASTM A951*
>
> *Exception: AISI Type 304 or Type 316 stainless steel wire conforming to ASTM A580/A580M, having a minimum yield strength of 45 ksi (310 MPa) and a minimum ultimate tensile strength of 90 ksi (620 MPa) is permitted to be used.*
>
> *Maybe add some commentary saying the exception is just for the material, and all other requirements of A951 have to be met.*
>
> *A better long-term solution is to change A951. Currently A951 does permit A580/A580M, Type 304, but there is an issue that the material properties (minimum yield of 70 ksi) do not work for stainless steel. Have A951 permit both Type 304 and Type 316, and change their requirements for stainless steel to the*

yield and ultimate we are establishing while keeping the requirements for carbon the same. This would be a good task for Mark McGinley.

Hochwalt Comment

In hindsight, it seems like it may not be clear that when joint reinforcement is fabricated with ASTM A580 stainless steel wire that the fabrication itself - welding and knurling of the wires - must still be in conformance with ASTM A951. How about ". . . or is fabricated in accordance with ASTM A951 with AISI Type 304 . . ."?

Both commenters identified the same potential issue and we agree that further clarification is necessary. This ballot has been prepared accordingly.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

None.

Code Commentary:

None

Specification:

The following reflects the passage of 20-RC-003:

2.4 D. *Joint reinforcement* — Provide joint reinforcement in accordance with the following:

1. Conforms to ASTM A951 or is fabricated in accordance with ASTM A951 with AISI Type 304 or Type 316 stainless steel wire conforming to ASTM A580/A580M, having a minimum yield strength of 45 ksi (310 MPa) and a minimum ultimate tensile strength of 90 ksi (620 MPa).
2. Maximum wire size shall not exceed one-half the specified mortar joint thickness. Do not use joint reinforcement with stacked wires whose total thickness exceeds one-half the specified mortar joint thickness.
3. Maximum spacing of cross wires in ladder-type joint reinforcement and of points of connection of cross wires to longitudinal wires of truss-type joint reinforcement shall be 16 in. (400 mm).

Specification Commentary:

2.4 D. *Joint reinforcement* — Code Section 9.1.9.3.2 limits the specified yield strength of joint reinforcement used to resist in-plane shear and flexural tension parallel to bed joints in strength design.

Where vertical reinforcement is present in a masonry wall, diagonal wires in the truss type joint reinforcement will conflict with placement of the vertical reinforcement. Mortar droppings on the diagonal cross wires also make quality grouting more difficult. Consequently, truss-type joint reinforcement should not be specified when the masonry contains vertical reinforcement.

Some manufacturers fabricate joint reinforcement with cross wires spaced at less than 16 in. (400 mm) on center. Joint reinforcement with non-modular dimensioned cross wires can interfere with placement of vertical reinforcement.

2.4.D.1 Commonly available ASTM A580/A580M stainless steel wire does not conform to the minimum yield and tensile strengths required by ASTM A951. ~~The exception allows the use of~~ Joint reinforcement fabricated with

this wire ~~and requires~~ is permitted, provided that it meets the minimum strength requirements for Type 304 or Type 316 cold-finished wire and is welded and knurled in accordance with ASTM A951.

Subcommittee Vote:				
9 *Affirmative*	2 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	3 *Did not vote*

Subcommittee Comments:
A subcommittee affirmative comment suggested a restructuring of the 2.4.D.1 sentence to remove the indefinite "it". This suggestion is incorporated into the above ballot.

Future business note: TMS Chair John Chrysler has submitted a change request to ASTM A951 that proposes to add A580/A580M steel to section 5.1, Table 1, of ASTM A951. If this change is approved, the next cycle should update this specification section accordingly.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-RC-006	
Technical Contact/Email: John M. Hochwalt / john.hochwalt@kpff.com	
Public Comment Number: 2022 Comment # 63	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment:

Public Comment 63 read as follows:

> *There appear to be no provisions for the anchorage of deformed wire placed mortar and used as shear reinforcing. Can it be terminated with hook like joint reinforcing as illustrated in CC-6.1-4?*

Response/Rationale:

The substance of this public comment has been addressed by ballot 20-RC-013. In reviewing comments received on that ballot, typographical errors were found in the code and commentary. This ballot proposes to correct those errors.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

6.1.8.1 *Horizontal shear reinforcement* — Horizontal reinforcement shall meet the requirements of Sections 6.1.8.1.1 through 6.1.8.1.~~4~~3.

Code Commentary:

The following reflects the commentary as approved by Ballot 20-RC-013.

6.1.8.1.3 The options for the anchorage of deformed wire in mortar are based on the provisions for the anchorage of joint reinforcement - 6.1.8.1.3 (a) is equivalent to 6.1.8.~~4.~~1.4 (b) for joint reinforcement, and 6.1.8.1.3 (b) is equivalent to 6.1.8.~~4.~~1.4 (c) for joint reinforcement. The joint reinforcement options in Section

6.1.8.~~4.~~1.4 are depicted in Figure CC-6.1-4; deformed wire would appear the same except that no cross wire would be present.

6.1.8.1.3 (b) is intended for use in applications where enhanced ductility is desirable. As discussed in the Code Commentary Section 6.1.8.1.4, testing of the detail in four-wire joint reinforcing suggests it provides ductility suitable for use in Special Reinforced Masonry Shear Walls.

Specification:

None.

Specification Commentary:

None.

Subcommittee Vote:									
11	*Affirmative*	0	*Affirmative w/ comment*	0	*Negative*	0	*Abstain*	3	*Did not vote*

Subcommittee Comments:

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-RC-007	
Technical Contact/Email: John M. Hochwalt / john.hochwalt@kpff.com	
Public Comment Number: 2022 Comment # 86	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment:

Public Comment 86 reads as follows:

> There are no limitations on the size of mechanical splices or requirements for their placement and protection. It is suggested mechanical splices be subject to the size limits of 6.1.3.2.4 and 6.1.3.2.5 (laps included limit); the placing requirements of 6.1.4.3 and 6.1.4.5, and the protection requirements of 6.1.5.1.
>
> In addition, mechanical splices are not addressed in TMS 602. It is suggested to list mechanical splices as required submittal in Section 1.5, and to address the installation of mechanical splices (in accordance with manufacturer's instructions) in 3.4 B.7. The installation instructions should also reference compliance with other relevant requirements such as 3.4 B.3, 3.4 B.4, 3.4 B.5.

Response/Rationale:

This comment was substantially addressed by ballot 20-RC-015. There were, however, two affirmative with comment votes on 20-RC-015 that this ballot addresses:

Bennett Affirmative with Comment

> *Nothing is ever easy. I like the ballot, but the cross-sectional area is not always easily defined. For example, are the screws in the Zap Screwlock, https://www.barsplice.com/zap-screwlok.html, included in the cross-sectional area? Or the port that sticks out in Cadweld splices, https://www.erico.com/newsdetail.asp?newsid=82. I would think not, but I may be wrong. A little commentary about whether minor protrusions are considered part of the cross-sectional area or not would be helpful. Thank you.*

This ballot proposes to provide additional commentary, as requested.

Robinson Affirmative with Comment

Would it be clearer to place these new requirements (Section 6.1.7.2.3) into the appropriate sections in 6.1.3 and 6.1.4 to have all size and placement limits in one location in the code.

Due to the need to use a common set of concepts (greatest cross-sectional dimension, cross-sectional area, protrusions) that are unique to mechanical splices, it is helpful to keep the mechanical splice provisions together. We also believe it will be more convenient to users to have one section of code that contains all provisions for mechanical splices. As an aid to users who might look in Sections 6.1.3 or 6.1.4 for requirements for mechanical couplers, this ballot proposes to add commentary to point the user to Section 6.1.7.2.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

The following reflects the passage of 20-RC-015.

6.1.7.2 *Mechanical splices*

6.1.7.2.1 *Bar reinforcement* — Mechanical splices shall have the bars connected to develop in tension or compression, as required, at least 125 percent of the specified yield strength of the bar.

6.1.7.2.2 *Deformed wire reinforcement* — Mechanical splices shall have the deformed wires connected to develop the specified tensile strength of the wire. Mechanical splices shall not be used for deformed wire placed in mortar.

6.1.7.2.3 *Size and placement* – Mechanical splices shall meet the following additional requirements:

(a) The greatest cross sectional dimension of the mechanical splice shall not exceed one-third of the least dimension of the gross grout space in which it is placed.

(b) The cross-sectional area of the mechanical splice shall be treated as lapped reinforcement for the purpose of determining compliance with Section 6.1.3.2.5.

(c) The clear distance limitations between bars and between deformed wires required in Sections 6.1.4.1 and 6.1.4.2 shall also apply to the clear distance between a mechanical splice and adjacent splices or reinforcement. For the purpose of this provision, consider the nominal diameter of the splice to be the greatest cross sectional dimension of the mechanical splice.

(d) The thickness of grout between the mechanical splice and the masonry units shall comply with Section 6.1.4.5.

(e) The mechanical splice shall have a masonry cover of 2 in. (50.8 mm) from any masonry face exposed to earth or weather and 1 ½ in. (38.1 mm) from all other masonry faces.

Code Commentary:

6.1.3 *Size of reinforcement*

Properties of bar and wire reinforcement are given in Table CC-6.1.3. The listed data for wire, which are based on ASTM A1064, provide calculated equivalent designations in SI units for reference although wires in those sizes may not be produced as metric wires. Not all incremental wire size data from ASTM A1064 are included to keep the table size reasonable while providing data for wires most useful to designs based on this Code. The Code requires single wire reinforcement to be deformed per Section 6.1.1.c, as does Specification Article 2.4E. W1.7 (9 gage) and W2.8 (3/16 inch) plain wires are not listed in ASTM A1064 but are included in Table CC- 6.1.3 because these wire sizes are used to produce joint reinforcement. The industry commonly uses the term "standard joint reinforcement" to refer to joint reinforcement with W1.7 (9 gage) longitudinal wires and the term "heavy-duty joint reinforcement" to refer to joint reinforcement with W2.8 (3/16 inch) longitudinal wires. Although joint reinforcement longitudinal wires are knurled, they are not deformed in accordance with ASTM A1064 and, therefore, are designated as plain wires.

Limitations on the size of mechanical splices are provided in Section 6.1.7.2.3.

. . .

6.1.4 *Placement of bar and deformed wire reinforcement*

Placement limits for reinforcement are based on successful construction practice over many years. The limits are intended to facilitate the flow of grout between bars and between wires. A minimum spacing between bars in a layer prevents longitudinal splitting of the masonry in the plane of the bars. The prohibition on bundled bars and deformed wires stems from the lack of research on masonry with bundled reinforcement. It is important that bars and deformed wires be placed accurately. Reinforcing bar positioners are available to control bar position.

Requirements for the placement of mechanical splices are provided in Section 6.1.7.2.3.

. . .

The following reflects the passage of 20-RC-015.

6.1.7.2 *Mechanical splices*

6.1.7.2.1 *Bar reinforcement* —Mechanical splices are also required to develop 125 percent of the specified yield strength in tension or compression as required, for the same reasons discussed for full welded splices.

6.1.7.2.2 Deformed wire reinforcement — Mechanical splices of deformed wire are required to develop the specified tensile strength of the deformed wire instead of 125 percent of the yield strength as is required for reinforcing bars because the minimum specified tensile strength (85 ksi) of ASTM A1064 deformed wire is less than 125 percent of the minimum specified yield strength (75 ksi). Mechanical couplers that have been developed and tested for reinforcing bars may not be suitable for deformed wires due to differences in yield strength and deformations. Mechanical splices of deformed wires in mortar is not permitted because the coupler does not fit in the mortar joint.

6.1.7.2.3 *Size and placement* – This section adapts the size limitations and placement requirements of Sections 6.1.3, 6.1.4 and 6.15 to mechanical splices, to maintain appropriate clearances for grouting and protection of the mechanical splice. If multiple bars are mechanically spliced in the same grout space, the splices may be staggered to achieve compliance with this section.

The references to cross-sectional area and greatest cross-sectional dimension of the mechanical splice are intended to refer to the main body of the splice, not to localized protrusions from the body such as bolt heads or

ports. Clear distance and cover requirements should be met at all portions of the coupler, including at localized protrusions.

Specification:

The following reflects the passage of 20-RC-015.

3.4 B. Reinforcement

. . .

3. Maintain clear distance between reinforcing bars or mechanical splices and the interior of masonry unit or formed surface of at least 1/4 in. (6.4 mm) for fine grout and 1/2 in. (12.7 mm) for coarse grout, except where cross webs of hollow units are used as supports for horizontal reinforcement. Maintain the same clear distance when deformed wire is specified to be embedded in grout.

4. Place reinforcing bars, deformed wire, and mechanical splices in grout maintaining the following minimum cover:

a. Masonry face exposed to earth or weather: 2 in. (50.8 mm) for bars larger than No. 5 (M #16) and mechanical splices; 1½ in. (38.1 mm) for deformed wire and No. 5 (M #16) bars or smaller.

b. Masonry not exposed to earth or weather: 1½ in. (38.1 mm).

5. Maintain minimum clear distance between parallel bars, parallel deformed wires, and mechanical splices of the nominal reinforcement size or 1 in. (25.4 mm), whichever is greater. For mechanical splices, the nominal reinforcement size is the least cross sectional dimension of the mechanical splice.

. . .

Specification Commentary:

3.4 B. Reinforcement

. . .

3, 4, and 5. The orientation of mechanical splices that have localized protrusions from the main body of the coupler, such as bolt heads or ports, may need to be adjusted to achieve the specified clearances and cover distances.

Renumber subsequent sections

Subcommittee Vote:				
11 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	3 *Did not vote*

Subcommittee Comments:

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-RC-008	
Technical Contact/Email: John M. Hochwalt / john.hochwalt@kpff.com	
Public Comment Number: 2022 Comment # 95	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment:

Public Comment 95 read as follows:

> *In talking with designers, there seems to be confusion about the application of the provision for development of hooked bars in Section 6.1.6.3.3, with some designers believing that l_e is the development length of a hooked bar, and others believing that the development length of a hooked bar is l_d - l_e. Can this be clarified?*

Response/Rationale:

The comment was addressed by Ballot 20-RC-012. That ballot received three affirmative with comment votes – one from Bennett addressing some editorial items, one from Walkowicz expressing support for revisiting this topic next cycle, and the following comment from Robinson:

> *The language in the commentary "It is expected that a more refined and potentially less conservative equation for l_{dh} will be developed for a future addition of this code." is not helpful. At this time, there does not seem to be enough research on this topic to say whether a new provision will or will not be developed in the future.*

The basis for this sentence was that a comparison of the ACI 318 equations for straight and hooked development lengths shows a much greater benefit for hooks in concrete than the TMS 402 equation shows for hooks in masonry. Given the similarities between the mechanics of concrete and masonry, it seems highly likely that the TMS 402 equation for hooked development passed in Ballot 20-RC-012 can be improved with further study and/or research.

The intent of having a comment like this in the commentary was threefold:

- Acknowledge to users a known potential issue with the hooked development length equation. Particularly users familiar with development length in concrete may wonder why hooks are so much less beneficial in masonry than in concrete.
- As a reminder for future code development committees that this provision would likely warrant further study. This cycle, for example, a similar comment in the commentary for non-participating elements in Chapter 7 prompted a TAC comment that led to the development of deformation compatibility provisions. There other "acorns" like this elsewhere in the commentary.
- As a clue to researchers or others that exploring the benefits of hooks in masonry may be a fruitful area of study.

This ballot proposes to revise this commentary to address the first bullet point more squarely.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

None.

Code Commentary:

The following reflects the passage of 20-RC-012.

6.1.6.3.3 Standard hooks — Historically, standard hooks were considered to be able to develop a stress in the bar or wire of 7,500 psi. The remainder of the stress in the bar due to design loads was required to be developed in bond along the straight length of bar starting at the tangent point of the hook. When the bond stress model for development of bars was replaced by Equation 6-2, the 7,500 psi was converted into an equivalent embedment length of $13d_b$. The minimum distance from the point where the bar needed to be developed to the tangent point of the hook~~,~~ was determined by subtracting $13d_b$ from Equation 6-1 or Equation 6-2. Equation 6-3 now defines a hooked development length, ℓ_{dh}, in a manner consistent with ACI 318. The β factor in Equation 6-3 was determined by subtracting from $13d_b$ the inside radius of hook determined from TMS 602 Table 6 and one bar or wire diameter, resulting in a value for ℓ_{dh} measured to the outside of the bar at the hook. This is illustrated in Figure CC-6.1-3.

When compared to the hooked development length equation in ACI 318, Equation 6-3 suggests that hooks are less effective in masonry than in concrete. This is likely an artifact of the historical basis of Equation 6-3, and is not indicative of a fundamental difference between concrete and masonry. ~~It is expected that a~~ A more refined and potentially less conservative equation for ℓ_{dh} ~~will be~~ is anticipated to be developed for a future edition of this Code.

In compression, hooks are ineffective and cannot be used as anchorage.

Specification:

None.

Specification Commentary:

None.

Subcommittee Vote:				
10 *Affirmative*	1 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	3 *Did not vote*

Subcommittee Comments:
A subcommittee affirmative comment suggested a restructuring of the last sentence of the second paragraph to remove the indefinite “it”. This suggestion is incorporated into the above ballot.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-RC-009	
Technical Contact/Email: Heather Sustersic, hsustersic@colbycoengineering.com	
Public Comment Number: 2022 Comment # 86	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment:

Public Comment 86 was addressed in ballot item 20-RC-015 that received 41 affirmative votes and two affirmative with comment votes. Ballot item 21-RC-007 addresses the two affirmative comments received on 20-RC-015, but in updating the working draft, a grammatical issue was discovered that could be read to imply that the minimum clear distance between reinforcing bars and mechanical splices applied to either reinforcing bars *or* mechanical splices. The intent was for the minimum spacing requirement to apply to both reinforcing bars and mechanical splices.

Response/Rationale:

This ballot proposes to correct Specification section 3.4 B.3 to require clear distance that minimum clear distances are provided for reinforcing bars *and* mechanical splices. Out of an abundance of clarity, the phrase 'reinforcing bars in mechanical splices' is also included to capture the potential for a reinforcement to be installed out of plumb with the minimum clear distance requirement still met.

Here is the section that passed under 20-RC-015, for voter reference:

3.4 B. Reinforcement

3. Maintain clear distance between reinforcing bars <u>or mechanical splices</u> and the interior of masonry unit or formed surface of at least 1/4 in. (6.4 mm) for fine grout and 1/2 in. (12.7 mm) for coarse grout, except where cross webs of hollow units are used as supports for horizontal reinforcement. Maintain the same clear distance when deformed wire is specified to be embedded in grout.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown <u>underlined</u> and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

None.

Code Commentary:

None

Specification:

The following reflects the passage of 20-RC-015.

3.4 B. Reinforcement

. . .

3. Maintain clear distance between the interior of masonry unit or formed surface and reinforcing bars ~~or~~, mechanical splices, and reinforcing bars in mechanical splices ~~and the interior of masonry unit or formed surface~~ of at least 1/4 in. (6.4 mm) for fine grout and 1/2 in. (12.7 mm) for coarse grout, except where cross webs of hollow units are used as supports for horizontal reinforcement. Maintain the same clear distance when deformed wire is specified to be embedded in grout.

Specification Commentary:

None.

Subcommittee Vote:				
7 *Affirmative*	1 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	6 *Did not vote*

Subcommittee Comments:

The affirmative comment suggested a clarification to the rationale that is incorporated herein.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-RC-010	
Technical Contact/Email: Heather Sustersic, hsustersic@colbycoengineering.com	
Public Comment Number: 2022 Comment # 95	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment:

Public Comment 95 was addressed in ballot item 20-RC-012 that received 40 affirmative votes and 3 affirmative with comment votes. Ballot item 21-RC-008 addresses the affirmative comments received on 20-RC-012, but in updating the figure numbering in the working draft, it was discovered that figure CC-6.1-5 is not referenced in the text in either the code or specification.

Response/Rationale:

This ballot proposes to insert a reference to Figure CC-6.1-5 in Commentary section 6.1.8.1.3. A spelling mistake and commentary numbering are also proposed to be corrected.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

6.1.8.1.3.1 Where the joint reinforcement consists of two longitudinal wires, both of the wires shall be anchored either by one of the following:

(a) Placement of the vertical reinforcement between adjacent cross-wires, or

(b) A 90-degree bend in longitudinal wires bent around the edge cell and with at least 3-in. (76-mm) bend extensions in mortar or grout, or

(c) A 90-degree bend in longitudinal wires bent around the edge cell and with at least 4-in. (102-mm) overlap of the wires in mortar or grout.

6.1.8.1.3.2 Where the joint reinforcement consists of four longitudinal wires, all four of the wires shall be anchored by either:

(a) A 90-degree bend in the inner longitudinal wires bent around the edge cell and with at least 3-in. (76-mm) bend extensions in mortar or grout, and a 3/16 in. (5 mm) U-stirrup lapped at least 8-in. (205-mm) with the outer wires, or

(b) A 90-degree bend in both the inner and outer longitudinal wires bent around the edge cell and with

at least 4-in. (102-mm) overlap of the wires in mortar or grout.

Code Commentary:

6.1.8.1.3.1 The options described for anchoring joint reinforcement are illustrated in Figure CC-6.1-4. Option (a) was used in the testing performed by Baenziger and Porter (2018) and demonstrated performance adequate for use in special reinforced masonry shear walls. While option (c) was not used in the testing, the good performance of overlapped wires in the four wire specimens demonstrated the adequacy of this detail. Option (b) has not been tested for use in special reinforced masonry shear walls.

6.1.8.1.3.2 The options described for anchoring joint reinforcement are illustrated in Figure CC-6.1-45. Both options were used in the testing performed by Baenziger and Porter (2018) and demonstrated performance adequate for use in special reinforced masonry shear walls.

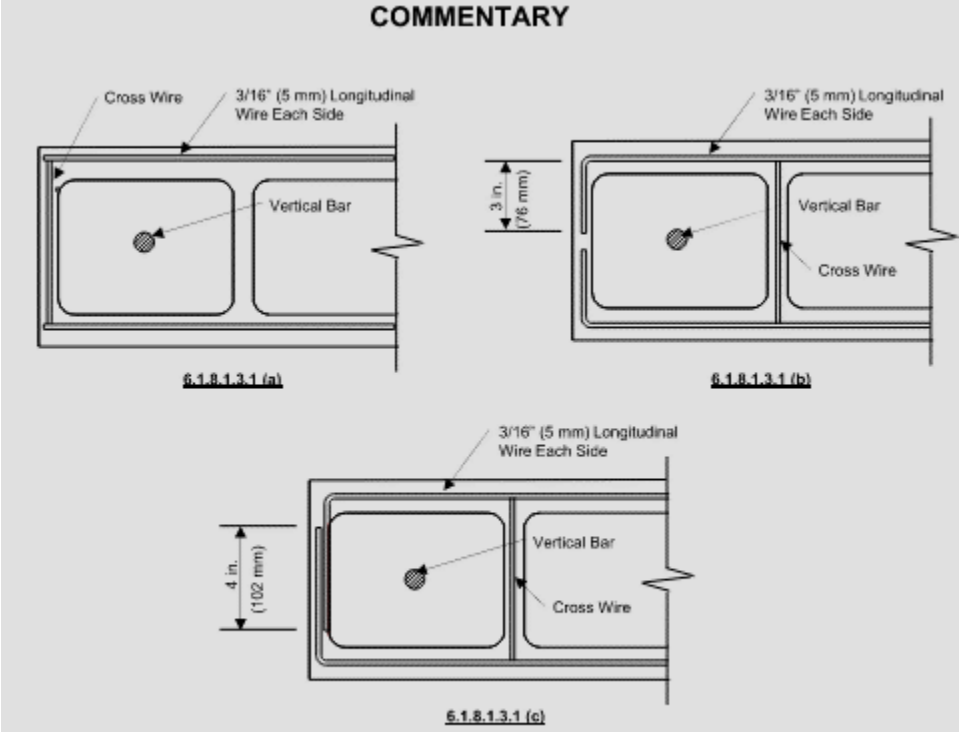


Figure CC-6.1-4 — Anchorage of joint reinforcement with two longitudinal wires

COMMENTARY

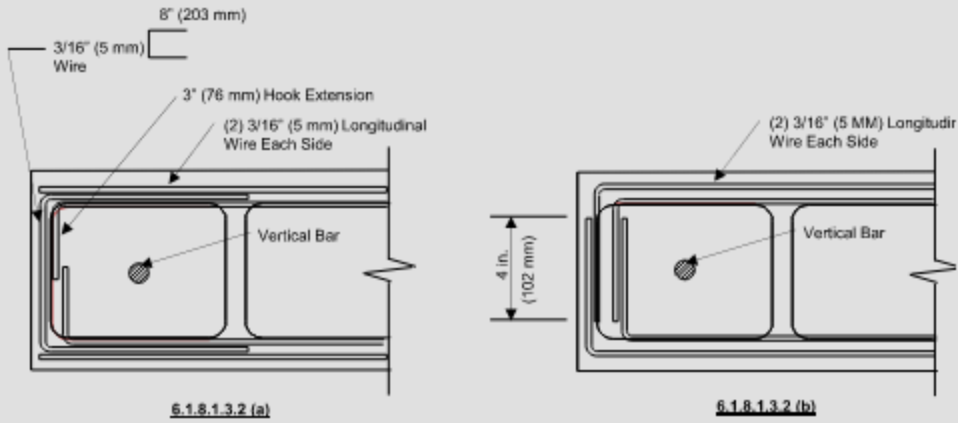


Figure CC-6.1-5 — Anchorage of joint reinforcement with four longitudinal wires

Specification:

None.

Specification Commentary:

None.

Subcommittee Vote:				
8 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	6 *Did not vote*

Subcommittee Comments:

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SL-01	
Technical Contact/Email: John M. Hochwalt / john.hochwalt@kpff.com	
Public Comment Number: 2022 Comment # 13	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment:

Public Comment 13 read as follows:

> Section 7.4.3.2.4 remains confusing. Are the first and second sentences separate topics, or are they intended to be related? Does the second sentence undo the first sentence? In other words, is the entire lateral force resisting system allowed to be provided by columns?

Response/Rationale:

The referenced code section addresses minimum requirements for the lateral force resisting system in SDC C+.

The code provision reads as follows:

> Along each line of lateral resistance at each story, at least 80 percent of the lateral stiffness shall be provided by seismic-force-resisting walls. Where seismic loads are determined based on a seismic response modification factor, R, not greater than 1.5, columns shall be permitted to be used to provide seismic load resistance.

The intent of the second sentence of the code is addressed by the last sentence of the commentary which states "The designer may opt to increase the percentage of lateral stiffness provided by columns if the structure is designed to perform elastically under seismic loads."

We agree with the commenter that the code could be clearer, and are proposing to indicate that the second sentence is an exception to the first sentence.

The commenter also raises the question as to whether the entire lateral force resisting system is permitted to consist of columns. This would be permitted by the TMS 402 provisions if the lateral force resisting system is designed to remain essentially elastic, that is with R = 1.5. The Building Code may, however, have restrictions that limit the use of masonry columns as a lateral force resisting system. For example, the International Building Code references ASCE 7 for seismic design, and ASCE 7 only acknowledges a limited number of masonry seismic-force-resisting systems as being code compliant. The recognized systems do not include masonry columns. This

is a similar situation as exists for other masonry lateral force resisting systems that are recognized by TMS 402 but not by ASCE 7, such as some prestressed wall types and infill systems. It is proposed to provide commentary to remind the user that the governing building code may have additional restrictions that limit the use of masonry columns to resist lateral loads.

Response to Comments on Previous Ballot:

When balloted as 19-SL-01, one negative vote was received from Pierson which was found persuasive by the committee. The associated comment read as follows:

> *If columns cannot be part of the seismic resisting system (as you indicated, IBC prohibits this), then they cannot resist lateral loads other than those generated by their own weight. Therefore, they cannot contribute to the stiffness of the building. Therefore, if we are tied to the IBC/ASCE 7, 100% of all strength and stiffness provided by masonry must be provided by walls. ASCE 7 actually allows me to share load between masonry walls and steel frames along the same line of resistance, provided I meet certain criteria and base the distribution on relative rigidities. So, realistically, IBC and ASCE 7 does allow steel braced frames to provide more than 20% of the stiffness along a line of lateral resistance, which would technically be prohibited by this provision. And the waters get muddier....*
>
> *I suggest that this entire section 7.4.3.2.4 be deleted. I think there are many times that engineers - particularly in areas of low seismicity - are combining steel braced frames with masonry walls along the same line and are not complying with this, nor should they be required to. We already require that loads be distributed to elements based on rigidities (4.1.6). Usage of columns to resist lateral loads would fall under section 1.3.*

None of the IBC, ASCE 7, or TMS 402 prohibit non-participating elements from providing stiffness; there is not a contradiction between treating these elements as non-participating elements and recognizing the stiffness that they contribute.

Deleting this section is not appropriate as it protects against conditions where columns with limited ductility resist a substantial portion of the load that is intended to be resisted by the more ductile seismic-force-resisting system.

The committee agreed that the provision needed to allow the use of seismic-force-resisting-systems other than masonry walls. As a result, the provision has been rewritten to place an upper bound on the contribution of masonry columns to stiffness rather than a lower bound on the contribution of masonry shear walls to stiffness.

Lastly the committee also agree that there was merit in recognizing that it is possible to use masonry columns – or any other system not recognized by ASCE 7 – to resist seismic loads through the use of provisions in TMS 402 (Section 1.3), the IBC and ASCE 7 (Section 1.3.1.3) that allow the use of alternatives to the code.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

7.4.3.2.4 *Lateral stiffness* — Along each line of lateral resistance at each story, ~~at least 80~~ not more than 20 percent of the lateral stiffness ~~shall~~ may be provided by masonry columns ~~seismic-force-resisting walls~~. Exception: Where seismic loads are determined based on a seismic response modification factor, R, not greater than 1.5, columns shall be permitted to contribute more than 20 percent of the lateral stiffness along any line of resistance and may be used to provide seismic load resistance.

Code Commentary:

7.4.3.2.4 *Lateral stiffness* — In order to accurately distribute loads in a structure subjected to lateral loading, the lateral stiffness of all structural members should be considered. Although structures may be designed to use solid or perforated shear walls for lateral-load resistance or lateral systems of other materials, masonry columns may also be incorporated for vertical capacity. The stipulation that masonry columns ~~seismic-force-resisting elements~~ provide not more than 20 ~~at least 80~~ percent of the lateral stiffness helps ensure that ~~additional elements, such as columns, do not significantly contribute to~~ the lateral stiffness is provided primarily by the seismic-force-resisting system. It is important in areas of high seismicity that most of the stiffness be provided by the more ductile seismic-force-resisting system and not by masonry columns that have limited ductility.

A line of lateral resistance refers to the plan view of participating members within a vertical plane that provide resistance to seismic forces, including torsional effects. Potential lines of lateral resistance that do not include walls should be considered in determining whether compliance with this section has been achieved. One can evaluate whether potential lines of resistance are in fact lines of resistance for which compliance with this section is required by removing those lines of resistance from the analysis and assessing the change in forces in the remaining lines of resistance. Members offset a small amount from each other such that their displacements along the line of resistance are similar should be considered to comprise a single line of resistance. See Figure CC-7.4-1 for an illustration of lines of lateral resistance.

Based on typical design assumptions, the lateral stiffness of structural elements should be based on cracked section properties for reinforced masonry and uncracked section properties for unreinforced masonry.

The designer may opt to increase the percentage of lateral stiffness provided by masonry columns if the structure is designed to perform elastically under seismic loads. The legally adopted building code may have restrictions on the use of masonry columns to resist seismic loads. For example, ASCE 7 does not currently recognize masonry columns as a seismic-force-resisting system. In such cases it may be necessary to treat masonry columns relied upon for seismic force resistance as an alternate system for the purpose of code compliance and acceptance by the authority having jurisdiction.

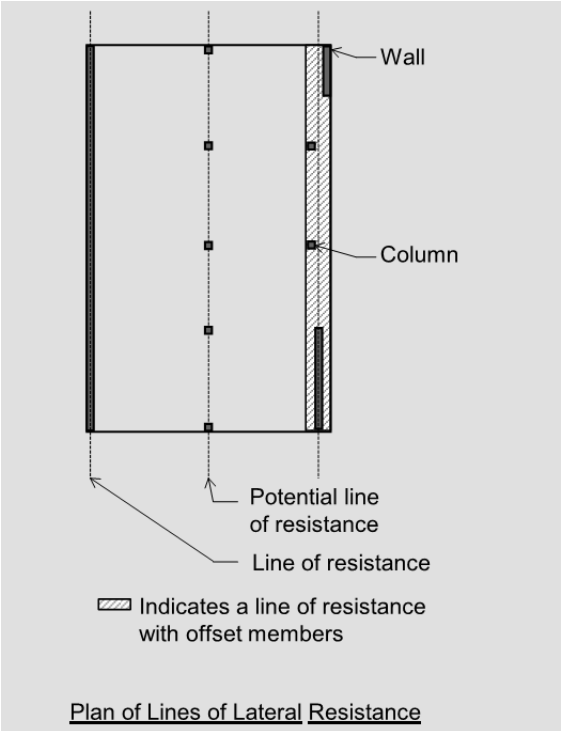


Figure CC-7.4-1 —Lines of lateral resistance

Specification:

None

Specification Commentary:

None

Subcommittee Vote:				
11 *Affirmative*	2 *Affirmative w/ comment*	1 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments:

Jackson: Negative vote reads as follows:

> *My thoughts follow Dave's and Alan's previous comments and the proposed solution just digs a deeper hole. I also think section 7.4.3.2.4 should be deleted, I should be able to have as many masonry columns as I want regardless if they provide a lot of stiffness to the building, I see this as a good thing. There is a response in the ballot that the provision is needed to protect the non ductile columns, I disagree because this protection is provided by other means such as story drift limits.*

The comment is provided for the main committee's consideration. No changes have been made in response to this comment.

Without Section 7.4.3.2.4, TMS 402 would allow a lateral system consisting of solely of masonry columns in any building, in any seismic design category. There is no research to support such a system. Research on concrete columns would suggest that much higher levels of confinement would be required to achieve a degree of ductility appropriate for higher seismic design categories than is currently required for participating masonry columns. While ASCE 7 would prohibit a masonry column system (unless the alternate system provision was used), TMS 402 should not rely on ASCE 7 to prevent the misuse of masonry systems.

Lepage: Affirmative with comment vote reads as follows:

> *Last sentence is missing "of": "...for the purpose of code compliance..."*
>
> *Note that Fig. CC-7.4-1 invites the designer to ignore the line of columns as a line of resistance with the use of "Potential line of resistance". This implies that the designer can also ignore a line of columns colinear with a line of resistance to comply with the 20% limit.*
>
> *I'm not sure if this is the intent. If not, a patch is needed*.

The typo noted has been corrected for the main committee ballot.

The existing commentary addresses the second issue raised: “Potential lines of lateral resistance that do not include walls should be considered in determining whether compliance with this section has been achieved. One can evaluate whether potential lines of resistance are in fact lines of resistance for which compliance with this section is required by removing those lines of resistance from the analysis and assessing the change in forces in the remaining lines of resistance.”

Sommer: Affirmative with comment votes reads as follows:

> *Editorial: Last sentence, "for the purpose of code compliance..."*

The typo noted has been corrected for the main committee ballot.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SL-06	
Technical Contact/Email: John M. Hochwalt / john.hochwalt@kpff.com	
Public Comment Number: 2022 Comments # 94	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment:

Public Comment 94 read as follows:

> The last sentence in 7.4.4.2.1 is redundant with the first sentence of 5.3.1.4 (d). Can it be deleted?

Response/Rationale:

This comment has been addressed by passage of Ballot 20-SL-06. That ballot, however, received an affirmative with comment vote from Trimble:

> *I would recommend that the word "lateral" be added before "tie" in new Section 7.4.4.2.1 to differentiate from other types of ties (veneer and wall). I spent some time clarifying all references to ties throughout the code as we made the transition to veneer tie. :)*

We agree with this clarification.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

Code provisions below reflect the passage of 20-SL-06. No changes proposed in code; code is provided for the voter's reference only.

7.4.4.2.1 *Minimum reinforcement for masonry columns* — Lateral ties in masonry columns shall be spaced not more than 8 in. (203 mm) on center and shall be at least 3/8 in. (9.5 mm) diameter.

Code Commentary:

Commentary guidance below reflects the passage of 20-SL-06.

7.4.4.2.1 *Minimum reinforcement for masonry columns* — Adequate lateral restraint is important for column reinforcement subjected to overturning forces due to earthquakes. Many column failures during earthquakes have been attributed to inadequate lateral tying. For this reason, closer spacing of lateral ties than might otherwise be required is prudent. An arbitrary minimum spacing has been established through experience. Columns not involved in the seismic-force-resisting system should also be more heavily tied at the tops and bottoms for more ductile performance and better resistance to shear.

The larger minimum lateral tie diameter required by this provision makes it more likely that units may need to be modified to accommodate the lateral ties as is discussed in the commentary to Section 5.3.1.4.

Specification:

None

Specification Commentary:

None

Subcommittee Vote:									
14	*Affirmative*	0	*Affirmative w/ comment*	0	*Negative*	0	*Abstain*	6	*Did not vote*

Subcommittee Comments:

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SL-09	
Technical Contact/Email: John M. Hochwalt / john.hochwalt@kpff.com	
Public Comment Number: 2022 Comments # 114	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☐ ***Committee agrees with Public Comment, change is proposed***

☒ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment:

Public Comment 114 read as follows:

The notation and nomenclature used in TMS 402 to discuss lateral building movements is inconsistent and should be revised for clarity.

The following nomenclature is used for story drifts:

- Calculated story drift, Δ. This notation is defined in Section 2.1. From Section 7.2.4 it can be inferred that that this is intended to include inelastic seismic displacements.
- Design story drift, which includes inelastic displacements and is a defined term in Section 2.2.

The notation Δ is not necessary as it is not used in any formulas; it is suggested to only use the term "design story drift." Alternatively, the notation $\underline{C_d}\Delta$ could be used in conjunction with "design story drift," to make the inclusion of inelastic effect more transparent and the notation more consistent with that used for system drifts.

System (top of wall) drifts are defined using the notation $C_d\delta_{ne}$ where δ_{ne} is defined in Section 2.1 as "displacements calculated using code-prescribed seismic forces and assuming elastic behavior." While it can be inferred that this is measured at the top of wall, consider making that part of the definition.

Some minor other suggestions related to drifts include:

- Delete the reference to the "equivalent lateral force method" in the definition of design story drift in Section 2.1. This is applicable to all elastic analyses.
- Delete the reference to "flexible frame systems" in the commentary to section 4.1.4 as the behavior described is not limited to flexible frame systems.
- Reference the ASCE 7 provisions for building separations in the discussion of building separations in the commentary to Section 7.2.4.

Response/Rationale:

This comment has been addressed by passage of Ballot 20-SL-09. That ballot, however, received several affirmative with comment votes that we agree should be addressed.

Lepage Affirmative with Comment

> *Two comments:*
>
> *1) Consider dropping the use of "critical value" and "critical neutral axis", instead simply refer to ccr. This occurs at two locations, one in the paragraph immediately before Figure CC -9.3-3 of Commentary to 9.3.5.6.2.3 and in first sentence of item (a) of Commentary to 9.3.5.6.2.5..*
>
> *Note that ccr is the neutral axis meeting the condition of Eq. 2a or 2b at the critical section of the wall (chosen at the base of the wall). It is odd to call it the "critical" neutral axis.*
>
> *2) Equation 6 has a typo, (1.5 Cd dne) in the denominator needs to be replaced with (d MCE).*

The first comment goes beyond the scope of the public comment and will be tracked as potential new business for the next code cycle. The second comment is correct and is addressed by this ballot.

Bennett Affirmative with Comment

> *Section 11.3.6.6.2 also needs to be changed similar to the changes in 9.3.5.6.2.3.*

We agree and have made the suggested revisions in this ballot.

Trimble Affirmative with Comment

> *In new wording of subparagraphs 1 and 2 of Section 7.2.4, the phrase "in the code" should be "in this code". I believe that is the appropriate phrasing that is now used throughout the document.*

We agree and have made the suggested revisions in this ballot.

Pierson Affirmative with Comment

> *My only concern is that the ASCE 7-22 just got published. I assume the final language in the published version matches the public comment version which was referenced in this ballot?*

ASCE 7-22 will be checked prior to submitting this ballot to main and any necessary adjustments will be made.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

Code provisions below reflect the passage of 20-SL-09.

11.3.6.6.2 This Section applies to walls bending in single curvature in which the flexural limit state response is governed by yielding at the base of the wall. Walls not satisfying those requirements shall be designed in accordance with Section 11.3.6.6.3.
(a) Special boundary elements shall be provided over portions of compression zones where:

$$c \geq \frac{l_w}{600(\frac{C_d}{\delta_{ne}}\delta_{ne}\ \underline{\delta_{MCE}}/h_w)}$$

and *c* is calculated for the P_u given by ASCE/SEI 7 Load Combination 6 (1.2D + E_v + E_h + L + ~~0.2~~0.15S) or the corresponding strength design load combination of the legally adopted building code, and the corresponding nominal moment strength, M_n, at the base critical section. The load factor on *L* in Load Combination 6 is reducible to 0.5, as per exceptions to Section 2.3.6 of ASCE/SEI 7.

Code Commentary:

Commentary guidance below reflects the passage of 20-SL-09.

7.2.4 *Drift limits* — Excessive deformation, particularly resulting from inelastic displacements, can potentially result in instability of the seismic-force-resisting system. This section provides procedures for the limitation of story drift. The term “drift” has two connotations:

1. “Story drift” is the maximum calculated lateral displacement within a story (the calculated displacement of one level relative to the level below caused by the effects of design seismic loads). In ~~the~~ this Code, notation using an upper case delta (Δ) is used to indicate relative story displacements.
2. The calculated lateral displacement or deflection due to design seismic loads is the absolute displacement of any point in the structure relative to the base. This is not "story drift" and is not to be used for drift control or stability considerations because it may give a false impression of the effects in critical stories. However, it is important when considering seismic separation requirements and is used in determining rotation demands on cantilevered walls and limit mechanisms. In ~~the~~ this Code, notation using a lower case delta (δ) is used to indicate displacements relative to the base.

. . .

9.3.5.6.2.5 This Code requires that testing be done to verify that the detailing provided is capable of developing a strain capacity in the boundary element that would be in excess of the maximum imposed strain. Reasonably extensive tests need to be conducted to develop prescriptive detailing requirements for specially confined boundary elements of intermediate as well as special reinforced masonry shear walls.

(a) Figure CC-9.3-3 shows that when the neutral axis depth *c* exceeds the critical neutral axis depth c_{cr}, the extreme compression fiber strain in the masonry reaches a value ε_{mm} in excess of the maximum usable strain ε_{mu}. The corresponding ultimate curvature ϕ is ε_{mu}/c. Based on the model of Figure CC-9.3-2(b) with $l_p = l_w/2$ and assuming the wall experiences the Risk-Targeted Maximum Considered Earthquake (MCE_R) event.

$$\delta_{MCE} = \theta_p h_w = (\phi_p l_p) h_w = \left(\frac{\varepsilon_{mm}}{c}\frac{l_w}{2}\right) h_w \text{ (Equation 3)}$$

From Equation 3:

$$\varepsilon_{mm} = 2\left(\frac{\delta_{MCE}}{h_w}\right)\left(\frac{c}{l_w}\right) \text{ (Equation 4)}$$

The wall length over which the strains exceed the limiting value of ε_{mu}, denoted as c'', can be determined using similar triangles from Figure CC-9.3-3:

$c'' = c\left(1 - \frac{\varepsilon_{mu}}{\varepsilon_{mm}}\right)$ (Equation 5)

An expression for the required length of confinement can be developed by combining Equations 4 and 5:

$\frac{c''}{l_w} = \frac{c}{l_w} - \frac{(\varepsilon_{mu}/2)}{(\sout{1.5C_d\delta_{xe}}\underline{\delta_{MCE}}/h_w)}$ (Equation 6)

The term c/l_w in Equation 6 accounts for the influence of material properties (f'_m, f_y), axial load, geometry, and quantities and distribution of reinforcement, whereas the term $(\varepsilon_{mu}/2)/(\delta_{MCE}/h_w)$ accounts for the influence of system response (roof displacement) and the maximum usable strain of masonry.

The wall length over which special transverse reinforcement is to be provided is based on Equation 6, with a value of (δ_{MCE}/h_w) = 0.015:

$\frac{c''}{l_w} = \frac{c}{l_w} - \frac{(0.003/2)}{0.015} = \frac{c}{l_w} - 0.1 \geq \frac{c}{2}$ (Equation 7)

The value of $(\delta_{MCE}/h_w) = 0.015$ was selected to provide an upper-bound estimate of the mean drift ratio of typical masonry shear wall buildings designed in accordance with ASCE, based on a maximum permitted drift of 0.01 in the design earthquake, amplified by a 1.5 factor for the MCE_R event. Thus, the length of the wall that must be confined is conservative for many buildings. The value of c/2 represents a minimum length of confinement, is adopted from ACI 318-99, and is arbitrary.

Specification:

None

Specification Commentary:

None

Subcommittee Vote:				
12 *Affirmative*	1 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	7 *Did not vote*

Subcommittee Comments:

Lepage: Affirmative with comment

> *Note that comment No. 1 in my previous A/C vote (Ballot 20-SL-09) was not asking for a technical change, it was simply compact Code writing. It should be reconsidered.*

The subcommittee chair will ask whether the proposed change may be treated as editorial.

2022 TMS 402/602 Committee
Proposed Negative Resolution to Masonry Standard

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SL-18 Main	
Technical Contact/Email: Jason Thompson / jthompson@ncma.org	
Resolving Negative on Ballot Item: 20-SL-018	
Negative Voter(s): Richard Bennett and Dave Pierson	

This ballot item proposes to find negative(s):

☐ ***Persuasive, Substantive***

☐ ***Persuasive, Editorial***

☒ ***Non-persuasive***

☐ ***Unrelated***

Negative Vote from Dick Bennett:

I agree with the changes to Chapter 6. This would be very helpful.

I do not agree with requiring hooks for all prescriptive reinforcement for special reinforced shear walls. There are several reasons for this.

1. We have discussed whether prescriptive horizontal reinforcement should be required to be hooked for years. We reached a resolution earlier, when the requirement for hooks was deleted from Chapter 7. To now require all horizontal reinforcement to be hooked is a huge change late in the cycle.

2. The data provided did not really show a difference between hooked bars and straight bars. I don't think it could be argued that there is a statistically significant difference from Figure 8.

3. John Hochwalt provides a compelling argument for not requiring hooked bars for prescriptive reinforcement in TMS Responds, Vol. 16, No. 1, March 2018. At a minimum if the shear demand is low enough hooks should not be required. Given the shear capacity provisions, it seems a reasonable limit would be 2/5.5*1.5 = 0.54, or if the shear demand is than half the shear strength of the masonry then hooks would not be required. (The 1.5 is the R factor for unreinforced masonry; the 2 is for the shear capacity design provisions doubling the shear). Or even 2/5.5=0.36, or if the shear demand were about 1/3 of the masonry shear strength hooks would not be required. Or even more conservative, 1.5/5.5=0.27, or if the shear demand is less than 1/4 of the masonry shear shear strength hooks would not be required.

4. With the Rigid Wall, Flexible Diaphragm procedure introduced in ASCE/SEI 7, the walls are not relied upon for ductility. There does not seem to be a compelling reason to require hooked bars in this case.

A reasonable compromise this late in the cycle would be to keep special shear walls as in 2016. Make the change in Chapter 6, require shear reinforcement in special walls to be hooked, and leave it open as to whether prescriptive horizontal reinforcement needs to be hooked or not and try to provide better guidance next cycle.

Negative Vote from Dave Pierson:

In my humble opinion, this is a very, very problematic change. In SDC "D", which is much of the western states, Engineers have no option to use anything other than Special Shear Walls, even though many of those walls have shear stresses in the wall that approach 5 psi or lower (Think Big-Box, i.e. a large market for masonry if we can keep it). The prescriptive horizontal reinforcing will never be engaged. This provision would force such walls to have hooked ends on the horizontal bars, which is ridiculous.

Ironically, the public comment begins with this sentence...."The requirement to hook all horizontal reinforcement regardless of strength or ductility needs is too onerous"... This is TRUE, even for SDC "D" when demands are low.

This is really a problem that ASCE 7 has created, by eliminating the option for any walls other than "Special" in SDC "D". But for now, we need to recognize that many special walls in SDC "D" do not need the horizontal reinforcing to resist loads, so please don't force a hook at the ends of prescriptive reinforcing.

Rationale:

As background, 2022 Public Comment No. 116 requested that the requirements for prescriptive hooks at the end of shear reinforcement be relaxed so that they were not required for all scenarios (all load levels, all shear wall types, all SDCs, etc.) where shear reinforcement is necessary. This comment generated ballot item 20-SL-018 developed in collaboration between the Seismic and Reinforcement and Connectors Subcommittee that effectively removed the prescriptive hook requirements from Chapter 6 and introduced prescriptive hooks to Chapter 7 specifically and solely for special reinforced shear walls.

There's broad consensus that there are scenarios where hooks at the ends of shear reinforcement are necessary and numerous research investigations have shown that these hooks increase system ductility and performance, especially in high demand assemblies such as special reinforced shear walls. There's a concurrent school of thought, however, that hooks provide little or marginal benefit in scenarios where demand is low (as reflected in the negative votes).

This is a multi-part ballot item, where the main ballot proposes to find the negatives from Dick and Dave non-persuasive. With finding these negatives non-persuasive, prescriptive hooks would only be triggered for special reinforced shear walls similar to the provisions in place pre-402-16. Subsequent ballot items (Subpart 1, 2, 3, and 4) propose a series of lessening triggers for when prescriptive hooks are required for shear reinforcement in special reinforced shear walls. The subsequent ballot items are only valid if the finding of non-persuasive is upheld on the main ballot.

The ballot has been structured this way due to their only being one ballot remaining this code cycle and the importance of the issues involved. Alternate approaches were considered, including a new, stand-alone ballot that would not be contingent upon the resolution of negatives on Ballot 20-SL-18. The number of possible permutations that such a ballot would need to consider would be impractical.

If this ballot to find the negative voters non-persuasive fails, the provision that requires all shear reinforcement in all wall types and all seismic design categories to be hooked will remain in place for TMS 402-22. Relative to TMS 402-16, the hook requirements that applied to walls designed using strength design provisions will be extended to walls designed using the allowable stress design provisions.

Subcommittee Vote:				
10 *Affirmative*	1 *Affirmative w/ comment*	2 *Negative*	0 *Abstain*	7 *Did not vote*

Subcommittee Comments:

Jackson: Negative vote reads as follows:

> *I firmly support and agree with both Dave and Dicks negative on the ballot, I am going to reference the original ballot from Jason, here is a portion, "An important nuance here is how 'shear reinforcement' is currently defined by TMS 402 (the definition from Section 2.2 of the May 31, 2021 working draft is shown below). Reinforcement is only classified as 'shear reinforcement' when Vs > 0…that is, the reinforcement is needed to satisfy shear strength requirements. In the context of horizontal reinforcement, the current and historical TMS 402 provisions differ in two significant ways:*
>
> - *The current working draft of TMS 402 requires hooks at the ends of horizontal shear reinforcement regardless of load level or ductility demand; and*
> - *The current working draft of TMS 402 could produce a permitted design whereby special reinforced masonry shear walls do not have any hooks at the end of the horizontal reinforcement. "*
>
> *I would rather see the code stay where it is than support this ballot in hopes for an exception later to get hooks out of low stress walls. The way I currently understand the provision, prescriptive rebar does not need hooks, rebar that is needed to satisfy sheer stress needs hooks. I agree with this more than the proposed changes in this ballot.*

The comment is provided for the main committee's consideration.

McMillian: The comment did not argue against finding the negative voters non-persuasive, but discussed the relative merits of Parts 1 through 4 of the ballot. This comment has been included on the forms for Parts 1 through 4 for the voter's reference.

Other Comments: Shing, Robinson and Lepage also provided comments on this ballot. Like the McMillian negative, their comments addressed the relative merits of Parts 1 through 4, and their comments have been included on those forms for the voter's reference.

Summary of Voting for Parts 1 through 4.

This topic of when/if/how to invoke hooks on horizontal reinforcement (whether required for shear or stipulated prescriptively) has been debated for decades. Opinions on the subject are steadfast and research findings are mixed and nuanced. Potential solutions have been considered by the Reinforcement and Connectors Subcommittee, the Seismic Subcommittee as well as other Subcommittee from prior Committee structures. Some of these alternative provisions never made it out of Subcommittee, while others found new opposition at the Main Committee level. The common feature of all this previous balloting was they presented alternatives in isolation – one approach to resolving the issue with little availability to compromise on a potentially more palatable solution. The novel approach taken here is to present the Main Committee with multiple options concurrently to facilitate a comprehensive discussion at the next Main Committee meeting.

For subcommittee voting, the subcommittee chair requested that voters vote negative for those Parts that would be unacceptable to them. This was based on the underlying strategy for Parts 1 through 4 of the ballot which is to provide a series of options for the voter's consideration, in the hopes that a solution can be found that has sufficient support on the main committee to allow passage. That same request is be asked of the Main Committee in their consideration of this topic.

Note that the number of negatives votes received on some sub-part ballot items would have historically precluded them from being brought to the Main Committee for consideration. They are, nevertheless, being presented in their totality. A summary of the votes on the four parts is as follows:

	Part 1 Hook if V/F_{vm} or $V_u/\phi V_{nm}$ >0.15	Part 2 Hook if V/F_{vm} or $V_u/\phi V_{nm}$ >0.20	Part 3 Hook if V/F_{vm} or $V_u/\phi V_{nm}$ >0.40	Part 4 Hook if Required by Analysis
Affirmative	8	7	7	5
Affirmative with Comment	2	2	1	0
Negative	2	3	4	7
Did not vote	8	8	8	8

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #: 21**
Item #: 21-SL-18 Part 1		
Technical Contact/Email:	Jason Thompson / jthompson@ncma.org	
Draft Document Dated:	**11/5/2021**	
Reballot of Main Committee Item No.: NA	**Response to TAC Comment No.:** NA	**Response to Public Comment No.:** 116

Reference *(Choose from Drop-Down Menu)*	**Section/Article**
TMS 402 Code Section	7.3.2.5

Rationale: *(Rationale is explanatory and not part of the proposed revision)*

This ballot item is only valid with the passing of main ballot to find the negative voters on 20-SL-18 non-persuasive.

A series of modifications are proposed to the prescriptive detailing requirements for special reinforced shear walls specific to when hooks are triggered at the ends of shear reinforcement. Each modification is presented separately at an independent Part. Given opinions on these requirements, all are expected to draw negatives. The purpose of presenting several alternatives is to see if the Committee can come to consensus as to when prescriptive hooks should be triggered in special reinforced shear walls.

There is an argument that not all special reinforced shear walls will be subjected to the same loading conditions and in cases where the demand is low, a relaxation of the prescriptive detailing requirements should be permitted. The changes proposed here relax the requirement for prescriptive hooks at the ends of shear reinforcement when specified loading conditions are met.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

7.3.2.5 Special reinforced masonry shear walls — Design of special reinforced masonry shear walls shall comply with the requirements of Section 8.3, Section 9.3, or Appendix C. Reinforcement detailing shall also comply with the requirements of Section 7.3.2.2.1 and the following:

(a) In-plane flexural reinforcement shall be deformed reinforcing bars.

(b) The maximum spacing of vertical reinforcement shall be the smallest of one-third the length of the shear wall, one-third the height of the shear wall, and 48 in. (1219 mm) for masonry laid in running bond and 24 in. (610 mm) for masonry not laid in running bond.

(c) The maximum spacing of horizontal reinforcement shall not exceed 48 in. (1219 mm) for masonry laid in running bond and 24 in. (610 mm) for masonry not laid in running bond.

(d) The maximum spacing of horizontal reinforcement required to resist in-plane shear shall be the smaller of one-third the length of the shear wall and one-third the height of the shear wall. Horizontal reinforcement required to resist in-plane shear shall be uniformly distributed.

(e) Joint reinforcement and deformed wire placed in mortar required to resist in-plane shear shall be a single piece without splices for the length of the wall used for shear design, d_v.
(f) The vertical reinforcement ratio shall be at least one-third of the horizontal reinforcement ratio required to resist in-plane shear. The sum of the horizontal reinforcement ratio and vertical reinforcement ratio shall be at least 0.002. Reinforcement ratios shall be based on the gross cross-sectional area of the wall, using specified dimensions and shall be not less than the following.

1. For masonry laid in running bond, the minimum reinforcement ratio in each direction shall be at least 0.0007.
2. For masonry not laid in running bond, the minimum vertical reinforcement ratio shall be at least 0.0007. The minimum horizontal reinforcement ratio shall be at least 0.0015.

Reinforcement used for compliance with these provisions shall be uniformly distributed.
(g) Joint reinforcement used as shear reinforcement shall be anchored in accordance with Section 6.1.8.1.1 (a) or (c) when two longitudinal wires are used and Section 6.1.8.1.2 when four longitudinal wires are used.
(h) Mechanical splices in flexural reinforcement in plastic hinge zones shall meet the requirements of Section 6.1.7.2.1 and develop the specified tensile strength of the spliced bar.
(i) When the ratio of V/F_{vm} for masonry designed in accordance with Chapter 8 or when the ratio $V_u/\varphi V_{nm}$ for masonry designed in accordance with Chapter 9, 10, or 11 exceeds 0.15, the ~~The~~ termination of horizontal reinforcement embedded in grout shall meet one of the following:

1. Except at wall intersections, the ends of horizontal reinforcement shall be bent around the edge vertical reinforcement with a 180-degree standard hook.
2. At wall intersections, horizontal reinforcement shall be bent around the edge vertical reinforcement with a 90-degree standard hook and shall extend horizontally into the intersecting wall a minimum distance at least equal to the development length.

Code Commentary:

7.3.2.5 (i) Research (Seif Eldin (2017)) has shown an increase in the ductility of masonry piers where the horizontal reinforcement is hooked around the edge vertical bar. When the demand-to-resistance ratio is less than 15%, the masonry would be expected to respond elastically during a risk-targeted maximum considered earthquake (Hochwalt (2018)).

Add the following to the list of commentary references for Chapter 7:

Hochwalt, J., and Bennett, R. (2018). “Hook Requirements for Special Reinforced Masonry Shear Walls,” TMS Responds, Vol. 16, No. 1.

Specification:
None.

Specification Commentary:

None.

Mandatory Requirements Checklist:
None.

Optional Requirements Checklist:
None.

Subcommittee Vote:

8	*Affirmative*	2	*Affirmative w/ comment*	2	*Negative*	0	*Abstain*	8	*Did not vote*

Subcommittee Comments:

McMillian: Negative

I believe the thresholds in Parts 1 and 2 would be too low to capture many partially grouted big box buildings in my area, and although they are partially grouted, they still have a lot of shear wall lengths and typically don't need shear reinforcement by calculation.

Shing: Affirmative

I voted affirmative on Parts 1 and 2 of this ballot. However, I feel more comfortable with Part 1.

Robinson: Affirmative

We already have provisions that look at the MCE_R levels (special boundary elements in 9.3.5.6.2 and Appendix C) to provide ductility for a wall in large seismic events. Sub ballot part 1 provisions bring similar limits to ensure continued ductility. The other sub ballots do not provide sufficient limits to ensure the wall will behave as anticipated during such large events.

Lepage: Affirmative

In Sub Ballot Item 1, the commentary states that for demand-to-resistance less than 15% (related to shear strength), elastic response is expected. Note that shear demands can be low even if the wall is yielding in flexure. Consider using "expected to have low ductility demands ~~respond elastically~~ during a..." The use of the word "ductility" also ties it nicely with the preceding sentence of the commentary.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #: 21**
Item #: 21-SL-18 Part 2		
Technical Contact/Email:	Jason Thompson / jthompson@ncma.org	
Draft Document Dated:	**11/5/2021**	
Reballot of Main Committee Item No.: NA	**Response to TAC Comment No.:** NA	**Response to Public Comment No.:** 116

Reference *(Choose from Drop-Down Menu)*	**Section/Article**
TMS 402 Code Section	7.3.2.5

Rationale: *(Rationale is explanatory and not part of the proposed revision)*

This ballot item is only valid with the passing of main ballot to find the negative voters on 20-SL-18 non-persuasive.

A series of modifications are proposed to the prescriptive detailing requirements for special reinforced shear walls specific to when hooks are triggered at the ends of shear reinforcement. Each modification is presented separately at an independent Part. Given opinions on these requirements, all are expected to draw negatives. The purpose of presenting several alternatives is to see if the Committee can come to consensus as to when prescriptive hooks should be triggered in special reinforced shear walls.

There is an argument that not all special reinforced shear walls will be subjected to the same loading conditions and in cases where the demand is low, a relaxation of the prescriptive detailing requirements should be permitted. The changes proposed here relax the requirement for prescriptive hooks at the ends of shear reinforcement when specified loading conditions are met.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

7.3.2.5 Special reinforced masonry shear walls — Design of special reinforced masonry shear walls shall comply with the requirements of Section 8.3, Section 9.3, or Appendix C. Reinforcement detailing shall also comply with the requirements of Section 7.3.2.2.1 and the following:

(a) In-plane flexural reinforcement shall be deformed reinforcing bars.

(b) The maximum spacing of vertical reinforcement shall be the smallest of one-third the length of the shear wall, one-third the height of the shear wall, and 48 in. (1219 mm) for masonry laid in running bond and 24 in. (610 mm) for masonry not laid in running bond.

(c) The maximum spacing of horizontal reinforcement shall not exceed 48 in. (1219 mm) for masonry laid in running bond and 24 in. (610 mm) for masonry not laid in running bond.

(d) The maximum spacing of horizontal reinforcement required to resist in-plane shear shall be the smaller of one-third the length of the shear wall and one-third the height of the shear wall. Horizontal reinforcement required to resist in-plane shear shall be uniformly distributed.

(e) Joint reinforcement and deformed wire placed in mortar required to resist in-plane shear shall be a single piece without splices for the length of the wall used for shear design, d_v.
(f) The vertical reinforcement ratio shall be at least one-third of the horizontal reinforcement ratio required to resist in-plane shear. The sum of the horizontal reinforcement ratio and vertical reinforcement ratio shall be at least 0.002. Reinforcement ratios shall be based on the gross cross-sectional area of the wall, using specified dimensions and shall be not less than the following.

1. For masonry laid in running bond, the minimum reinforcement ratio in each direction shall be at least 0.0007.
2. For masonry not laid in running bond, the minimum vertical reinforcement ratio shall be at least 0.0007. The minimum horizontal reinforcement ratio shall be at least 0.0015.

Reinforcement used for compliance with these provisions shall be uniformly distributed.
(g) Joint reinforcement used as shear reinforcement shall be anchored in accordance with Section 6.1.8.1.1 (a) or (c) when two longitudinal wires are used and Section 6.1.8.1.2 when four longitudinal wires are used.
(h) Mechanical splices in flexural reinforcement in plastic hinge zones shall meet the requirements of Section 6.1.7.2.1 and develop the specified tensile strength of the spliced bar.
(i) When the ratio of V/F_{vm} for masonry designed in accordance with Chapter 8 or when the ratio $V_u/\varphi V_{nm}$ for masonry designed in accordance with Chapter 9, 10, or 11 exceeds 0.20, the ~~The~~ termination of horizontal reinforcement embedded in grout shall meet one of the following:

1. Except at wall intersections, the ends of horizontal reinforcement shall be bent around the edge vertical reinforcement with a 180-degree standard hook.
2. At wall intersections, horizontal reinforcement shall be bent around the edge vertical reinforcement with a 90-degree standard hook and shall extend horizontally into the intersecting wall a minimum distance at least equal to the development length.

Code Commentary:

7.3.2.5 (i) Research (Seif Eldin (2017)) has shown an increase in the ductility of masonry piers where the horizontal reinforcement is hooked around the edge vertical bar. When the demand-to-resistance ratio is less than 20%, the masonry would be expected to respond elastically during a design based earthquake (Hochwalt (2018)).

Add the following to the list of commentary references for Chapter 7:

Hochwalt, J., and Bennett, R. (2018). “Hook Requirements for Special Reinforced Masonry Shear Walls,” TMS Responds, Vol. 16, No. 1.

Specification:
None.

Specification Commentary:

None.

Mandatory Requirements Checklist:
None.

Optional Requirements Checklist:
None.

Subcommittee Vote:

7 *Affirmative*	2 *Affirmative w/ comment*	3 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments:

McMillian: Negative

I believe the thresholds in Parts 1 and 2 would be too low to capture many partially grouted big box buildings in my area, and although they are partially grouted, they still have a lot of shear wall lengths and typically don't need shear reinforcement by calculation.

Robinson: Negative

We already have provisions that look at the MCE_R levels (special boundary elements in 9.3.5.6.2 and Appendix C) to provide ductility for a wall in large seismic events. Sub ballot part 1 provisions bring similar limits to ensure continued ductility. The other sub ballots do not provide sufficient limits to ensure the wall will behave as anticipated during such large events.

Shing: Affirmative

I voted affirmative on Parts 1 and 2 of this ballot. However, I feel more comfortable with Part 1. As to Part 2, if we consider $V_u/(\phi V_{nm})$ x 1.5.x 5, with 1.5 for MCE and 5 for the R factor, we will have an actual demand to capacity ratio of 1.5. Assuming an overstrength of 1.5, the MCE seismic force demand on the wall may barely reach the shear strength ϕV_{nm}. Nevertheless, the low demand to capacity ratio considered here may have already taken into account of the system overstrength. The possible overstrength associated with the V_{nm} of a wall depends on f'_m and wall aspect ratio. Walls with very low shear span ratios may have larger overstrength in V_{nm}. Since this provision applies to this situation, I am also comfortable with Part 2.

Lepage: Affirmative

In Sub Ballot Item 2, same comment made for item 1 applies. Of the two versions, I prefer using 20% or 40% instead of 15%. It is arbitrary, therefore a single significant figure is sufficient.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee			**Ballot #: 21**
Item #: 21-SL-18 Part 3			
Technical Contact/Email:	Jason Thompson / jthompson@ncma.org		
Draft Document Dated:	**11/5/2021**		
Reballot of Main Committee Item No.: NA	**Response to TAC Comment No.:** NA	**Response to Public Comment No.:** 116	

Reference *(Choose from Drop-Down Menu)*	**Section/Article**
TMS 402 Code Section	7.3.2.5

Rationale: *(Rationale is explanatory and not part of the proposed revision)*

This ballot item is only valid with the passing of main ballot to find the negative voters on 20-SL-18 non-persuasive.

A series of modifications are proposed to the prescriptive detailing requirements for special reinforced shear walls specific to when hooks are triggered at the ends of shear reinforcement. Each modification is presented separately at an independent Part. Given opinions on these requirements, all are expected to draw negatives. The purpose of presenting several alternatives is to see if the Committee can come to consensus as to when prescriptive hooks should be triggered in special reinforced shear walls.

There is an argument that not all special reinforced shear walls will be subjected to the same loading conditions and in cases where the demand is low, a relaxation of the prescriptive detailing requirements should be permitted. The changes proposed here relax the requirement for prescriptive hooks at the ends of shear reinforcement when specified loading conditions are met.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

7.3.2.5 Special reinforced masonry shear walls — Design of special reinforced masonry shear walls shall comply with the requirements of Section 8.3, Section 9.3, or Appendix C. Reinforcement detailing shall also comply with the requirements of Section 7.3.2.2.1 and the following:

(a) In-plane flexural reinforcement shall be deformed reinforcing bars.

(b) The maximum spacing of vertical reinforcement shall be the smallest of one-third the length of the shear wall, one-third the height of the shear wall, and 48 in. (1219 mm) for masonry laid in running bond and 24 in. (610 mm) for masonry not laid in running bond.

(c) The maximum spacing of horizontal reinforcement shall not exceed 48 in. (1219 mm) for masonry laid in running bond and 24 in. (610 mm) for masonry not laid in running bond.

(d) The maximum spacing of horizontal reinforcement required to resist in-plane shear shall be the smaller of one-third the length of the shear wall and one-third the height of the shear wall. Horizontal reinforcement required to resist in-plane shear shall be uniformly distributed.

(e) Joint reinforcement and deformed wire placed in mortar required to resist in-plane shear shall be a single piece without splices for the length of the wall used for shear design, d_v.
(f) The vertical reinforcement ratio shall be at least one-third of the horizontal reinforcement ratio required to resist in-plane shear. The sum of the horizontal reinforcement ratio and vertical reinforcement ratio shall be at least 0.002. Reinforcement ratios shall be based on the gross cross-sectional area of the wall, using specified dimensions and shall be not less than the following.

1. For masonry laid in running bond, the minimum reinforcement ratio in each direction shall be at least 0.0007.
2. For masonry not laid in running bond, the minimum vertical reinforcement ratio shall be at least 0.0007. The minimum horizontal reinforcement ratio shall be at least 0.0015.

Reinforcement used for compliance with these provisions shall be uniformly distributed.
(g) Joint reinforcement used as shear reinforcement shall be anchored in accordance with Section 6.1.8.1.1 (a) or (c) when two longitudinal wires are used and Section 6.1.8.1.2 when four longitudinal wires are used.
(h) Mechanical splices in flexural reinforcement in plastic hinge zones shall meet the requirements of Section 6.1.7.2.1 and develop the specified tensile strength of the spliced bar.
(i) When the ratio of V/F_{vm} for masonry designed in accordance with Chapter 8 or when the ratio $V_u/\varphi V_{nm}$ for masonry designed in accordance with Chapter 9, 10, or 11 exceeds 0.40, the ~~The~~ termination of horizontal reinforcement embedded in grout shall meet one of the following:

1. Except at wall intersections, the ends of horizontal reinforcement shall be bent around the edge vertical reinforcement with a 180-degree standard hook.
2. At wall intersections, horizontal reinforcement shall be bent around the edge vertical reinforcement with a 90-degree standard hook and shall extend horizontally into the intersecting wall a minimum distance at least equal to the development length.

Code Commentary:

7.3.2.5 (i) Research (Seif Eldin (2017)) has shown an increase in the ductility of masonry piers where the horizontal reinforcement is hooked around the edge vertical bar. When the demand-to-resistance ratio is less than 40%, inelastic response is generally expected, but coupled with the shear capacity check required for special reinforced shear walls, the effective R value for these systems is approximately 2 where the benefit of prescriptive hooks for shear reinforcement is marginal (Hochwalt (2018)).

Add the following to the list of commentary references for Chapter 7:

Hochwalt, J., and Bennett, R. (2018). "Hook Requirements for Special Reinforced Masonry Shear Walls," TMS Responds, Vol. 16, No. 1.

Specification:
None.

Specification Commentary:

None.

Mandatory Requirements Checklist:
None.

Optional Requirements Checklist:
None.

Subcommittee Vote:				
7 *Affirmative*	1 *Affirmative w/ comment*	4 *Negative*	0 *Abstain*	8 *Did not vote*

Subcommittee Comments:

Shing: Negative

Part 3 and 4 are beyond my comfort zone. The current methodology to derive the value of the R factor, namely the FEMA P-695 procedure, is based on the consideration of the collapse probability of a building. Under extremely loading conditions, the hooks could play a role in delaying collapse.

Robinson: Negative

We already have provisions that look at the MCE_R levels (special boundary elements in 9.3.5.6.2 and Appendix C) to provide ductility for a wall in large seismic events. Sub ballot part 1 provisions bring similar limits to ensure continued ductility. The other sub ballots do not provide sufficient limits to ensure the wall will behave as anticipated during such large events.

Lepage: Affirmative

In Sub Ballot Item 3, the commentary mentions R of approximately 2 on the basis of shear forces only, when a much higher R may be associated with the flexural strength. I suggest using a simpler rationale similar to the one provided in Sub Ballot Item 1.

McMillian: Affirmative

My first choice would be Part 4, which I guess is another way of saying when $V_u/\phi V_{nm} > 1$ (thinking only strength design here), thus making the designer hook the bars only if the shear reinforcement is needed by calculation as Chapter 6 intimates. Having said that, I could live with the Part 3 threshold conservatism.

grouted wall with, or without, a veneer. The expectation was the veneer, if used, would not contribute to the impact resistance, and would be stripped away during the high wind event. However, in 2014 additional testing was done on partially grouted, cavity wall systems utilizing both the back-up wall and the veneer to resist the missile impact. The veneer and tie system absorbs energy from the missile impact and dissipates it through the wall system. Localized damage, that should be repairable after the storm, occurs to the veneer and the tie at the missile strike location but the CMU face shows no visible damage – Figure 9. The ICC 500 test requires that no missile penetrates the interior of the shelter. Figure 10 shows that the interior CMU structural wall was not penetrated by the missile even in the sections which were not grouted. These new debris impact tests opened additional masonry wall configurations for use in tornado sheltering applications and in many cases for little additional cost. For more information and a detailed list of citations on the topic, see Reference 7.

Figure 9 - Localized damage at the impact locations. Note the damage to the tie and veneer but no damage visible to the CMU face.

Figure 10 - Ben Harris inspecting the interior side of the CMU after the debris impact testing.

Images courtesy of Diane Throop

Hook Requirements for Special Reinforced Masonry Shear Walls

16.1-3 We had a question regarding the standard hook requirement in TMS 402-16, Section 7.3.2.6(d). This provision is for Special Reinforced Masonry Shear Walls (SRMSW) and states "Shear reinforcement shall be anchored around vertical reinforcing bars with a standard hook." The question was when designing a special masonry shear wall and no shear reinforcement is required, does the prescriptive horizontal steel need to hook around vertical bars? It is clear that shear reinforcing must be hooked.

Response by John M. Hochwalt, *KPFF Consulting Engineers*, Richard Bennett, *University of Tennessee*, and Phillip Samblanet, *The Masonry Society*

This is a subject of ongoing debate. Many on the TMS 402/602 Committee believe that the TMS 402 specifically used the words it did to describe minimum prescriptive horizontal reinforcement in Special Reinforced Masonry Shear Walls (SRMSW's) versus shear reinforcement. Yes, shear reinforcement, required by ASD (Allowable Stress Design) or SD (Strength Design) to resist applied shear must end in a standard hook. But many contend that this does not mean that every horizontal bar in a shear wall is "shear reinforcement" and thus prescriptive horizontal steel does not have to end in a standard hook, especially when, for allowable stress design, F_v (Allowable Shear Stress) greatly exceeds f_v (calculated shear stress) , or ϕV_n (design shear strength) greatly exceeds V_u (factored shear load). This may be the case for a very long shear wall on a warehouse type building. In their view, prescriptive horizontal steel, or steel added for other reasons (crack control, or flexural steel if the wall spans horizontally between pilasters) does not serve as shear reinforcement, and is thus not required to end in a standard hook.

However, others argue that to achieve the favorable R value (Response Modification Factor) for SRMSW's, all horizontal bars must be hooked around vertical bars as the horizontal bars may need to resist shear in an extreme loading event. And so the argument continues.

While the debate shows that there is room for improvement of those provisions, the lack of consensus on this issue suggests that the decision whether to hook or not to hook may be best made on a project specific basis. We would encourage you to take advantage of that latitude to think about this provision critically and exercise your own professional judgment in deciding what is appropriate for your project. We would offer you the following questions to consider in deciding on what the right answer is for your project:

- What is the risk of not hooking the bars?
  - What is the ratio of f_v/F_{vm} or $V_u/\varphi V_{nm}$? (With f_v and V_u calculated without using the shear capacity provisions).
    - If the ratio is 1/8 or less, the wall is expected to respond elastically (uncracked) even in the MCER (risk targeted maximum considered earthquake event). It seems like the risk of not hooking the bars would be very low.
    - If the ratio is 1/5.5 or less, the wall is expected to respond elastically (uncracked) in the DBE (Design Based Earthquake) event. It seems like the risk of not hooking the bars would be low typically. See discussion about unhooked bars below for when that might not be true.
    - When the ratio is between 1/5.5 and 1/2.5, the risk increases as the ratio increases. Considering the shear capacity provisions, at most the effective R value would be 2.0, similar to an Ordinary Wall , which might be an argument that hooking is not required. One counterargument to not hooking the bars would be that our prediction of earthquake demands are imperfect at best; the key is detailing the system to be robust and ductile.
    - If the ratio is 1/2.5 or more, hooked shear reinforcing is required due to the shear capacity provisions.
  - If the wall cracks, how will unhooked bars influence wall behavior?
    - If the component being designed is a long, unperforated wall, the consequence of not hooking the horizontal steel may be low as loss of anchorage near the end of the wall may not greatly affect the integrity of the wall or its load carrying capacity.
    - If the component being designed is a narrow pier between openings, would the loss of anchorage due to cracking potentially result in loss of the pier? What would that mean for the overall performance of the structure?
  - How likely is the AHJ (Authority Having Jurisdiction) or inspector to insist on bars being hooked? (This very much varies by jurisdiction.)
- What are the consequences of hooking the bars? Proper detailing to ensure reinforcement, grout coverage, spacing/clearance requirements and tolerances can be accommodated is needed, along with care in the construction, especially during grouting operations. For example, in the wall shown in Figure 11, to accommodate the reinforcement the units had to be carefully cut on the left hand side to accommodate the reinforcement - an expensive and difficult process, requiring care when both cutting the units and later when grouting (to avoid "blowouts" of the grout). Also note that common procedure of "tilting" the shear reinforcement to fit in the available space allowing the proper bends on the standard hooks (rather than bending the bars tighter than permitted to "fit in the horizontal plan view", which can weaken the reinforcement because of the severe bends).
- What would adding hooks mean for the cost and constructability of your project?
  - If only some bars are hooked, will that be potentially confusing to the contractor / AHJ / inspector?
- What other issues may need to be considered?
  - While outside the purview of the TMS 402, you may be designing other components of the lateral system (for example diaphragms) assuming inelastic system behavior as represented by a high R value. If the wall is really responding elastically, or nearly so, what does that mean for the design of those other components?

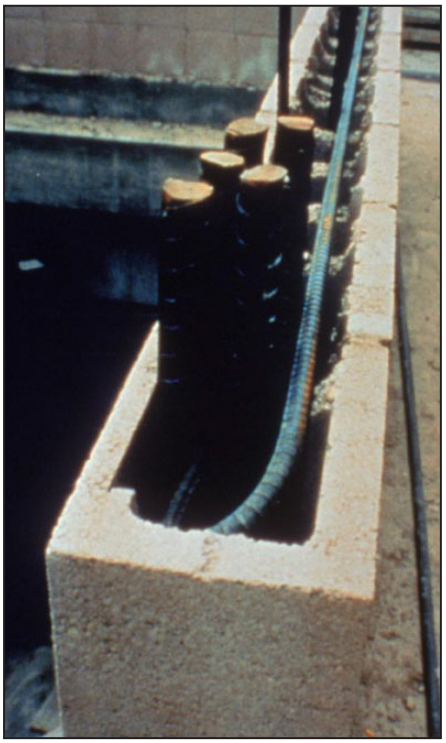


Figure 11 - Horizontal shear reinforcement is required to be anchored around vertical reinforcement with standard hooks for Special Reinforced Masonry Shear Walls (SRMSs). However, whether this is required on all horizontal bars in SMRSs is debatable. What is not debatable, is the congestion that can occur with significant vertical bars, lap splices, and horizontal bars with hooks in these potentially highly stressed locations.

References

1. TMS 402, Building Code Requirements for Masonry Structures, The Masonry Society, Longmont, CO, 2016, https://masonrysociety.org.

2. ASTM E488 / E488M-96 (2003), Standard Test Methods for Strength of Anchors in Concrete Elements, ASTM International, West Conshohocken, PA, 2015, www.astm.org.

3. TEK 12-03C Masonry Anchor Bolt Design Spreadsheet, http://ncma-br.org/pdfs/23/TEK12-03C-MSJC2013-MasonryAnchorBoltDesignVer1.1.xlsm.

4. 2018 International Existing Building Code (IEBC), The International Code Council, Washington, D.C., 2018, www.iccsafe.org.

5. IBC, International Building Code®, International Code Council, Washington, DC, 2015, 2018.

6. ICC 500, Standard for the Design and Construction of Storm Shelters, International Code Council, Washington, DC, 2014.

7. Tornado and High Wind Sheltering with Masonry, McGinley, W. M., Throop, Diane B., and Coulbourne, William L., 13th Canadian Masonnry Symposium, Canada Masonry Design Centre, 2017. www.canadamasonrydesigncentre.com.

This document is produced by:

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Questions, ideas, suggestions and differing opinions may be sent to TMS for consideration for inclusion in future issues of *TMS Responds*.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee			**Ballot #: 21**
Item #: 21-SL-18 Part 4			
Technical Contact/Email:	Jason Thompson / jthompson@ncma.org		
Draft Document Dated:	**11/5/2021**		
Reballot of Main Committee Item No.: NA	**Response to TAC Comment No.:** NA	**Response to Public Comment No.:** 116	

Reference *(Choose from Drop-Down Menu)*	**Section/Article**
TMS 402 Code Section	7.3.2.5

Rationale: *(Rationale is explanatory and not part of the proposed revision)*

This ballot item is only valid with the passing of main ballot to find the negative voters on 20-SL-18 non-persuasive.

A series of modifications are proposed to the prescriptive detailing requirements for special reinforced shear walls specific to when hooks are triggered at the ends of shear reinforcement. Each modification is presented separately at an independent Part. Given opinions on these requirements, all are expected to draw negatives. The purpose of presenting several alternatives is to see if the Committee can come to consensus as to when prescriptive hooks should be triggered in special reinforced shear walls.

There is an argument that not all special reinforced shear walls will be subjected to the same loading conditions and in cases where the demand is low, a relaxation of the prescriptive detailing requirements should be permitted. The changes proposed here relax the requirement for prescriptive hooks at the ends of shear reinforcement when specified loading conditions are met.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

7.3.2.5 Special reinforced masonry shear walls — Design of special reinforced masonry shear walls shall comply with the requirements of Section 8.3, Section 9.3, or Appendix C. Reinforcement detailing shall also comply with the requirements of Section 7.3.2.2.1 and the following:

(a) In-plane flexural reinforcement shall be deformed reinforcing bars.

(b) The maximum spacing of vertical reinforcement shall be the smallest of one-third the length of the shear wall, one-third the height of the shear wall, and 48 in. (1219 mm) for masonry laid in running bond and 24 in. (610 mm) for masonry not laid in running bond.

(c) The maximum spacing of horizontal reinforcement shall not exceed 48 in. (1219 mm) for masonry laid in running bond and 24 in. (610 mm) for masonry not laid in running bond.

(d) The maximum spacing of horizontal reinforcement required to resist in-plane shear shall be the smaller of one-third the length of the shear wall and one-third the height of the shear wall. Horizontal reinforcement required to resist in-plane shear shall be uniformly distributed.

(e) Joint reinforcement and deformed wire placed in mortar required to resist in-plane shear shall be a single piece without splices for the length of the wall used for shear design, d_v.
(f) The vertical reinforcement ratio shall be at least one-third of the horizontal reinforcement ratio required to resist in-plane shear. The sum of the horizontal reinforcement ratio and vertical reinforcement ratio shall be at least 0.002. Reinforcement ratios shall be based on the gross cross-sectional area of the wall, using specified dimensions and shall be not less than the following.

1. For masonry laid in running bond, the minimum reinforcement ratio in each direction shall be at least 0.0007.
2. For masonry not laid in running bond, the minimum vertical reinforcement ratio shall be at least 0.0007. The minimum horizontal reinforcement ratio shall be at least 0.0015.

Reinforcement used for compliance with these provisions shall be uniformly distributed.
(g) Joint reinforcement used as shear reinforcement shall be anchored in accordance with Section 6.1.8.1.1 (a) or (c) when two longitudinal wires are used and Section 6.1.8.1.2 when four longitudinal wires are used.
(h) Mechanical splices in flexural reinforcement in plastic hinge zones shall meet the requirements of Section 6.1.7.2.1 and develop the specified tensile strength of the spliced bar.
~~(i) The termination of horizontal reinforcement embedded in grout shall meet one of the following:~~

~~1. Except at wall intersections, the ends of horizontal reinforcement shall be bent around the edge vertical reinforcement with a 180-degree standard hook.~~
~~2. At wall intersections, horizontal reinforcement shall be bent around the edge vertical reinforcement with a 90-degree standard hook and shall extend horizontally into the intersecting wall a minimum distance at least equal to the development length.~~

Code Commentary:

~~7.3.2.5 (i) Research (Seif Eldin (2017)) has shown an increase in the ductility of masonry piers where the horizontal reinforcement is hooked around the edge vertical bar.~~

Specification:
None.

Specification Commentary:

None.

Mandatory Requirements Checklist:
None.

Optional Requirements Checklist:
None.

Subcommittee Vote:				
5 *Affirmative*	0 *Affirmative w/ comment*	7 *Negative*	0 *Abstain*	8 *Did not vote*

Subcommittee Comments:

Shing: Negative

Part 3 and 4 are beyond my comfort zone. The current methodology to derive the value of the R factor, namely the FEMA P-695 procedure, is based on the consideration of the collapse probability of a building. Under extremely loading conditions, the hooks could play a role in delaying collapse.

Robinson: Negative

We already have provisions that look at the MCE_R levels (special boundary elements in 9.3.5.6.2 and Appendix C) to provide ductility for a wall in large seismic events. Sub ballot part 1 provisions bring similar limits to ensure continued ductility. The other sub ballots do not provide sufficient limits to ensure the wall will behave as anticipated during such large events.

Lepage: Negative

Before voting Affirmative in Sub Ballot Item 4, I would like to see supporting documentation showing that the use of hooks is not associated with improved behavior of yielding walls.

McMillian: Affirmative

My first choice would be Part 4, which I guess is another way of saying when $V_u/\phi V_{nm} > 1$ (thinking only strength design here), thus making the designer hook the bars only if the shear reinforcement is needed by calculation as Chapter 6 intimates.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SL-20	
Technical Contact/Email: John M. Hochwalt / john.hochwalt@kpff.com	
Public Comment Number: 2022 Comment # 104	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☐ ***Committee agrees with Public Comment, change is proposed***

☒ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment:

Public Comment 104 read as follows:

The following suggestions are made relative to the treatment of prestressed shear walls in Chapter 7:

- 7.3.2.10 (a) and (e) have incorrect references to the special reinforced wall provisions. 7.3.2.5 (b), (c), and (d) should be referenced in lieu of 7.3.2.5 (a) and (b).
- In the first paragraph of the commentary for both 7.3.2.10 and 7.3.2.11, the commentary should state "bonded reinforcement" instead of "mild reinforcement" since 7.3.2.10 (e) allows the use of bonded prestressed reinforcement to meet the prescriptive requirements
- In the first paragraph of the commentary for both 7.3.2.10 and 7.3.2.11, the references to detailing requirements that are not required by the code should be deleted.
- It is suggested to delete 7.3.2.11 (a) as it is redundant relative to 7.3.2.10 (e).
- 7.3.2.11 (d) references 9.3.5.6 for ductility requirements. The classification of special reinforced prestressed walls in Table 9.3.5.6.1 should be clarified.
- In the commentary for Section 7.4.4, special prestressed walls should be added to the first sentence. This sentence should be moved to 7.4.4.2.

Response/Rationale:

This comment has been addressed by passage of Ballot 20-SL-20. That ballot, however, received two affirmative with comment votes that warranted being addressed.

Bennett Affirmative with Comment Vote:

Without all the background I think most users will find it strange for prestressed walls to appear somewhat out of the blue in Table 9.3.5.6.1. I think a better solution would be to modify 7.3.2.11 (d) to say: The requirements for special reinforced shear walls of Section 9.3.5.6 shall be met.

We agree and have addressed this comment below.

This also resolved the Robinson Affirmative with Comment vote about the change to Table 9.3.5.6.1.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

7.3.2.11 *Special reinforced prestressed masonry shear walls* — Special reinforced prestressed masonry shear walls shall comply with the requirements of Chapter 10, the reinforcement detailing requirements of Sections 7.3.2.2.1 and 7.3.2.10 and the following:

(a) The cross-sectional area of bonded tendons shall be considered to contribute to the minimum reinforcement in Sections 7.3.2.2.1 and 7.3.2.10.
(b) Prestressing tendons shall consist of bars conforming to ASTM A722/A722M.
(c) All cells of the masonry wall shall be grouted.
(d) The requirements for special reinforced shear walls of Section 9.3.5.6 shall be met. Dead load axial forces shall include the effective prestress force, $A_{ps}f_{se}$.
(e) The design shear strength, ϕV_n, shall exceed the shear corresponding to the development of 1.25 times the nominal flexural strength, M_n, of the element, except that the design shear strength, ϕV_n, need not exceed 2.0 times required shear strength, V_u.

. . .

Table 9.3.5.6.1: Strain in Extreme Tensile Reinforcement

Shear Wall	Tensile strain in reinforcement	
	$M_u/V_u d_v < 1$	$M_u/V_u d_v \geq 1$
Intermediate reinforced	$1.5\varepsilon_y$	$3.0\ \varepsilon_y$
Special reinforced~~, special prestressed~~	$1.5\ \varepsilon_y$	$4.0\ \varepsilon_y$

Code Commentary:

None.

Specification:

None.

Specification Commentary:

None.

Subcommittee Vote:				
14 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	6 *Did not vote*

Subcommittee Comments:

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SL-23	
Technical Contact/Email: John M. Hochwalt / john.hochwalt@kpff.com	
Public Comment Number: 2022 Comments # 147	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment:

In reference to the commentary for 7.4.4.2.1, Public Comment 147 read as follows:

> Consider updating this commentary. Would it be clearer to refer to beneficial effects of column ties as "confinement"? Also, the last phrase "and better resistance to shear" is incorrect. Shear will be constant over the height of the column; when heavier ties are provided at the top and bottom of the column it is to provide enhanced confinement of potential hinge regions.
>
> Should enhanced confinement of potential hinge regions be made mandatory?

Response/Rationale:

The first part of the comment was addressed by Ballot 19-SL-11 which has been passed by the committee. This ballot addresses the second part of the comment that asks “Should enhanced confinement of potential hinge regions be made mandatory?”

At the time of the public comment, the question was referencing the following sentence:

> *Columns not involved in the seismic-force-resisting system should also be more heavily tied at the tops and bottoms for more ductile performance and better resistance to shear.*

With the passage of 19-SL-11 that sentence now reads:

> *Columns not involved in the seismic-force-resisting system should also be more heavily tied at the tops and bottoms for more ductile performance in potential plastic hinge regions.*

In either case, this commentary places users in a difficult position by suggesting that enhanced confinement should be provided in non-participating columns, but without providing guidance as to what that confinement should be.

Rather than create new requirements for non-participating columns, the ballot proposes to require the same confinement in the end regions of non-participating columns as is required for the full height of participating columns. The end region is defined as twice the maximum column dimension, which is consistent with the way plastic hinge regions are defined by ACI 318 for concrete columns.

The confinement required for participating columns by Section 7.4.4.2.1 is based on the columns being designed for an R value not greater than 1.5 in accordance Section 7.4.3.2.4; i.e. a condition with limited ductility demands. This level of confinement is likely not sufficient to allow the development of a stable plastic hinge; concrete columns that are designed to accommodate plastic hinging are required to have much greater confinement. For example, in Seismic Design Category D, multiple legs of #5 ties are often spaced at 4 to 6 inches on center in hinging concrete columns.

Response to Comments on Previous Ballot:

Ballot 20-SL-23 first proposed a response to the remaining portion of this comment. That ballot received one affirmative with comment and two negative votes. Those comments were considered in the preparation of this ballot as follows.

Robinson Affirmative with Comment

> *The added commentary language "that is appropriate for columns designed with an R value not exceeding 1.5 per Section 7.4.3.2.4." is not necessary and does not need to be added. If this minimum reinforcement is appropriate for columns in Seismic Design Category D and above, why would it not be the same in Seismic Design Category C and above where the requirement for R = 1.5 is located. If it is only because the forces are higher in Seismic Design Category D, then the added commentary is not correct.*

The commentary language has been revised in consultation with Robinson to clarify why Section 7.4.3.2.4 was being referenced here.

Pierson Negative

> *This new proposed provision is not required. I believe that 7.3.1 and the exception to 7.3.1 cover what this is trying to address.*
>
> *What should change, honestly, is the commentary that was modified with the passage of 19-SL-11. That commentary should be modified as follows:*
>
> *"Non-isolated columns not involved in the seismic force resisting system should also...."*
>
> *Then, if you want to give some direction, add commentary to 7.3.1 which directs the engineer to Section 7.4.4.2.1 for reinforcing non-isolated columns if they are doing a compatibility analysis per the exception.*
>
> *Also, the addition of the word "participating" in 7.4.4.2.1 is not needed since it is a subsection to 7.4.4.2 which is "Design of participating elements". And the word "non-participating" is not required in 7.4.4.1.1 since it is a sub-section of 7.4.4.1 which is "Design of non-participating elements"*

Section 7.3.1 addresses the analysis and design requirements necessary to achieve the intended level of performance for nonparticipating elements; the proposed provision in Section 7.4.4.1.1 establishes the

minimum detailing requirements necessary for non-participating elements that are expected to experience demands beyond elastic. This is the typical approach taken throughout Chapter 7 where design and analysis provisions are complemented by detailing provisions. One is not a substitute for the other.

The words “nonparticipating” and “participating” have been deleted in the subsection headings as proposed.

Tawresey Negative

As written:

> **7.4.4.1.1** *Minimum reinforcement for non-participating masonry columns*. Lateral ties conforming to the requirements of Section 7.4.4.2.1 shall be provided for a length equal to twice the larger column dimension from the top and bottom of the column at each floor.

Comment: One of the column dimensions is its height.

Suggested language:

> **7.4.4.1.1** *Minimum reinforcement for non-participating masonry columns*. Lateral ties conforming to the requirements of Section 7.4.4.2.1 shall be provided for a length equal to twice the larger column *plan* dimension from the top and bottom of the column at each floor.

The word “plan” has been added to the code and commentary as suggested.

Lastly, in reviewing these comments it was noted that the load combination 7.3.1 needs to be updated to reflect the change in ASCE 7-22 to strength level snow loads. This change has also been proposed.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

7.3.1 *Nonparticipating elements* — Masonry elements that are not part of the seismic-force-resisting system shall be classified as nonparticipating elements and shall be isolated in their own plane from the seismic-force-resisting system. Isolation joints and connectors shall be designed to accommodate the design story drift.

Exception: Isolation is not required if a deformation compatibility analysis demonstrates that the non-participating element can accommodate the inelastic displacement, $C_d\delta_{ne}$, of the structure in a manner complying with the requirements of this code. Elements supporting gravity loads in addition their self-weight shall be evaluated for gravity load combinations of (1.2*D* + 1.0*L* + ~~0.2~~0.15*S*) or 0.9*D*, whichever is critical, acting simultaneously with the inelastic displacement and shall have a ductility compatible with the ductility of the lateral force resisting system. The influence of any non-isolated nonparticipating elements on the lateral force resisting system shall be considered in design in accordance with Section 4.1.6 of this code.

. . .

7.4.4 *Seismic Design Category D requirements*

Masonry elements in structures assigned to Seismic Design Category D shall comply with the requirements of Section 7.4.3 and with the additional requirements of Sections 7.4.4.1 and 7.4.4.2.
Exception: Design of participating elements of AAC masonry shall comply with the requirements of Section 7.4.3.

7.4.4.1 *Design of nonparticipating elements* — Nonparticipating masonry elements shall comply with the requirements of Chapter 8, 9, 10, 11, or 12. Nonparticipating masonry elements, except those constructed of AAC masonry, shall be reinforced in either the horizontal or vertical direction in accordance with the following:
(a) Horizontal reinforcement — Horizontal reinforcement shall comply with Section 7.4.3.1.1.
(b) Vertical reinforcement — Vertical reinforcement shall consist of at least one No. 4 (M #13) bar or one D20 (MD 29) wire spaced not more than 48 in. (1219 mm). Vertical reinforcement shall be located within 16 in. (406 mm) of the ends of masonry walls.

7.4.4.1.1 *Minimum reinforcement for masonry columns* — Lateral ties conforming to the requirements of Section 7.4.4.2.1 shall be provided for a length equal to twice the larger column plan dimension from the top and bottom of the column at each floor.

Exception: Compliance with this provision is not required if either of the following requirements are met:
(a) The column is isolated from building displacements in conformance with Section 7.3.1.
(b) An analysis complying with Section 7.3.1 demonstrates that the column will remain elastic when subjected to the required inelastic displacement.

7.4.4.2 *Design of participating elements* — Masonry shear walls shall be designed to comply with the requirements of Section 7.3.2.5, 7.3.2.8, or 7.3.2.11.

7.4.4.2.1 *Minimum reinforcement for masonry columns* — Lateral ties in masonry columns shall be spaced not more than 8 in. (203 mm) on center and shall be at least 3/8 in. (9.5 mm) diameter. Lateral ties shall be embedded in grout.

Code Commentary:

7.3.1 *Nonparticipating elements* — With regards to the exception, non-isolated, nonparticipating elements can influence a structure's strength and stiffness, and as a result the distribution of lateral loads and building irregularities. Non-isolated nonparticipating elements can inadvertently have significant effects on the performance of a structural system and are to be considered in accordance with the code. This should also be considered in accordance with other applicable provisions such as the modeling criteria of ASCE/SEI 7. Where partial height non-participating elements are constructed tight to building columns, this should include the consideration of short column effects.

The deformation compatibility analysis may consider the effect of cracking on element stiffness. Elements that are detailed to achieve ductile behavior may also develop plastic mechanisms. For example, elements detailed in accordance with the provisions for special reinforced masonry shear walls may be able to accommodate displacements through the development of plastic hinges. For such elements, Appendix C may be used to provide guidance on the determination of hinge rotation capacity. In addition to these provisions, other applicable provisions, such as the deformation limit and deformation compatibility provisions of ASCE/SEI 7 should be considered in design.

. . .

7.4.4.1.1 *Minimum reinforcement for masonry columns* — When columns are not isolated from building displacements, yielding of reinforcing steel or crushing of masonry may occur in response to those displacements. Providing a level of confinement consistent with that required for participating columns is intended to maintain column integrity in those conditions. The length of twice the larger column plan dimension represents the extent over which the inelastic behavior is expected to be concentrated.

This level of confinement may not be sufficient to allow the development of plastic hinges. If building displacements are to be accommodated through hinging of the non-participating columns, the rotation capacity of the columns will need to be assessed. See discussion in the commentary to Section 7.3.1 on the use of plastic hinges to accommodate building movements.

. . .

7.4.4.2.1 *Minimum reinforcement for masonry columns* — Adequate lateral restraint is important for column longitudinal reinforcement resisting compression forces due to earthquakes. Many column failures during earthquakes have been attributed to buckling of longitudinal reinforcement and inadequate confinement of concrete or masonry in compression. For this reason, closer spacing of lateral ties than might otherwise be required is prudent. An arbitrary minimum spacing has been established through experience that provides a limited amount of ductility, consistent with an R value not greater than 1.5 as required by Section 7.4.3.2.4. ~~Columns not involved in the seismic-force-resisting system should also be more heavily tied at the tops and bottoms for more ductile performance in potential plastic hinge regions.~~

Specification:

None

Specification Commentary:

None

Subcommittee Vote:				
12 *Affirmative*	2 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	6 *Did not vote*

Subcommittee Comments:

The affirmative with comment votes by Robinson and Sommer noted a typographical error whohc has been corrected in this ballot.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SL-024	
Technical Contact/Email: John M. Hochwalt / john.hochwalt@kpff.com	
Public Comment Number: 2022 Comment # 137	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☐ ***Committee agrees with Public Comment, change is proposed***

☒ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment:

Public Comment 137 read as follows:

> *Foundation dowels add resilience for better long term performance, and also improve construction safety of masonry walls. The concrete code has had dowel requirements for several years. Is there any consideration to adding a dowel requirement to the masonry code?*

Response/Rationale:

Response to Commenter

Significant effort was made this cycle to consider a requirement for foundation dowels. In addition to this ballot and its predecessor (20-SL-24), three main committee ballots on this topic were also considered in the course of this cycle.

As a Building Code, TMS 402 is intended to provide minimum standards relative to the life safety of the completed structure. TMS 602 supports TMS 402 in providing minimum standards of construction that have been assumed in the development of the TMS 402 Code. Neither document is intended to address construction site safety, which is the purview of regulatory agencies.

As such, this ballot does not address the possible safety benefits of requiring minimum foundation dowels. This ballot does however, consider the portion of the comment that suggests that minimum foundation dowels would add resilience and improved long term performance. It does so in the context of other building codes, specifically the concrete code (ACI 318).

In the context of current building codes, resilience is addressed through structural integrity provisions. The structural integrity provisions are intended to enhance the ability of the structure to survive unexpected conditions by providing minimum connections between parts of the structure and minimum continuous ties through the parts.

Extreme earthquakes – earthquakes stronger than anticipated by the building code – are a specific type of unexpected event that building codes are concerned about maintaining structural integrity through ductile detailing.

Thus, in response to this comment, it is proposed to add minimum dowel requirements to provide general structural integrity and resiliency in Seismic Design Categories A and higher, and more stringent requirements in Seismic Design Category D and higher that reflect the greater risk of extreme loading in these areas of higher seismic risk.

Previous Ballots

As noted above, three ballots related to minimum foundation dowels have been considered prior to then public comment period. Those ballots were:

- 2-SM-002: This ballot was in response to 2016 Public Comment 73 which proposed that the specification require the provision of foundation dowels. The ballot proposed to make no changes to the code or specification, with the rationale that this was a design issue and not a construction issue and that the design issue was adequately addressed by Section 4.1.1 which requires a continuous load path. This ballot received 2 negative votes. The negative votes were withdrawn, however, so that this ballot became the official response to 2016 Public Comment 73.
- 14-SM-008: This ballot proposed to require that foundation dowels be provided to match the vertical reinforcement of walls, columns and pilasters unless specifically designed otherwise. This ballot received 7 negative votes, one of which was found persuasive, terminating this ballot.
- 15B-SM-008: This ballot proposed a series of provisions addressing the interface of masonry with the foundations, based on the provisions in ACI 318-14. This ballot received 5 negative votes, one of which was found persuasive, terminating this ballot.

These ballots were included with ballot 20-SL-24, as was a response to the comments on ballot 15B-SM-008. Interested voters can access those materials by downloading the ballot items for Main Committee Ballot 20 from the ballot portal.

Consistent with ballot 2-SM-002, this ballot treats the provision of foundation dowels as a design issue. Commentary is provided to acknowledge that the contractor may want additional dowels for reasons of safety or to limit external bracing of the walls during construction, and to identify for the user when those additional dowels could affect the design.

Consistent with ballot 15B-SM-008, the foundation dowel provisions of ACI 318 are used as a model for developing provisions for TMS 402. This ballot, however, proposes to place the provisions in Chapter 7 rather than Chapter 5. The reason for this is that in higher seismic design categories, having dowels that match the wall reinforcement is important for achieving the required level of ductility, as is discussed in more detail below. Given the need to have foundation dowels in higher seismic design categories in Chapter 7, it is proposed to place all of the foundation dowel provisions in Chapter 7 for ease of user reference.

The Case Against Friction

> *Generally, connections between structural components should be ductile and have a capacity for relatively large deformations and energy absorption under the effect of abnormal conditions. This criteria may be met in many different ways, depending on the structural system used.*
>
> Excerpt from Commentary to ASCE 7-16 Section 1.4 on General Structural Integrity.

If there are no dowels at the interface between the masonry members and the foundation, friction due to gravity load is the only mechanism available to resist the member sliding in the in-plane or out-of-plane directions on the foundation. Especially in the out-of-plane direction, friction cannot accommodate large

deformations, nor can it absorb much energy. It is the responsibility of the TMS 402/602 committee to provide minimum requirements for the general structural integrity of masonry structural systems; providing minimum dowels is a good place to start.

Examples of extreme events that the general structural integrity provisions are intended to address cited in the ASCE 7 commentary include:

- Explosions caused by ignition of gas or industrial liquids
- Boiler failures
- Vehicle impact
- Impact of falling objects
- Effects of adjacent excavations
- Gross construction errors
- Very high winds such as tornadoes
- Sabotage

In these events it is expected that the capacity of the structure will be exceeded. If, however, the structure is connected together it will have a chance to deform, remain intact and standing. A load path reliant on friction alone will not achieve this intent, even if calculation shows the adequacy of such a load path. As stated in the ASCE 7 commentary "because accidents, misuse and sabotage are normally unforeseeable events, they cannot be defined precisely." Since the events are by their nature undefined, they fall outside of our ability to demonstrate acceptable safety through calculations.

As suggested by the commenter, the concrete code provides an instructive example for the provision of structural integrity. ACI 318-19 does not permit the load path between the concrete structure and the foundation to be solely reliant on friction. Relevant to this discussion, Section 16.3 provides minimum connection requirements for general structural integrity at the interface of the structure to the foundation. These provisions require minimum connections between concrete structural elements and the foundation even if calculations demonstrate that sufficient friction capacity is available to resist the code imposed loadings. The rationale for providing some minimal foundation dowels in areas of lower seismic demand is explained in the commentary to ACI 318-19 Section 16.3.4 which contains provisions for dowels or connections between concrete walls and foundations:

> The Code requires a minimum amount of reinforcement between all supported and supporting members to ensure ductile behavior. This reinforcement is required to provide a degree of structural integrity during the construction stage and during the life of the structure.

Similarly, the structural integrity provisions in ASCE 7, also require some minimum physical connections between structural components. For example, Section 1.4.4 in ASCE 7-16 for the anchorage of structural walls reads as follows:

> **1.4.4 Anchorage of Structural Walls.** Walls that provide vertical load bearing or lateral shear resistance for a portion of the structure shall be anchored to the roof and all floors and members that provide support for the for the wall or that are supported by the wall. The anchorage shall provide a direct connection between the walls and the roof or floor construction. The connections shall be capable of resting a strength level horizontal force perpendicular to the plane of the wall equal to 0.2 times the weight of the wall tributary to the connection, but not less than 5 psf.

Note this provisions uses words like "anchorage" and "connection" which would preclude the use of friction provide a continuous load path for integrity.

<u>Development of this Ballot</u>

The balance of this rationale is broken into three sections:

- Minimum area of dowels: This section discusses the rationale behind the minimum area of steel crossing the interface between the masonry elements and the foundation.
- Embedment of dowels into the foundation: The section discusses the anchorage of the dowels into the foundation.
- Splicing of dowels with vertical reinforcement: This section discusses the rationale for requiring the dowels to be spliced with the vertical wall reinforcement.

Minimum Area of Dowels

In Seismic Design Categories D and higher, it is proposed to require that the wall dowels match the grade, size and spacing of the vertical wall reinforcement provided at the base of the wall. The reason for this is that that the seismic design forces in these seismic design categories are determined assuming that the lateral force resisting system can achieve a significant of inelastic behavior through yielding of the reinforcement. If the dowels do not match the wall reinforcement at the base of the wall, the inelastic behavior will be concentrated at the interface which may result in tensile rupture of the reinforcement rather than ductile yielding.

For the same reason, the commentary underlines that while only certain reinforcing may be relied upon in determining the flexural capacity, matching dowels must be provided for all reinforcing.

An exception is provided if the interface is evaluated for tension using forces determined with an R value not greater than 1.5. The rationale for the exception is that if there is no tension at the interface under essentially elastic loading that the inelastic demands at the interface will be quite limited.

The rationale for dowels for participating columns in high seismic regions is essentially the same. In accordance with Section 7.4.3.2.4, participating columns are required to be designed for R not greater than 1.5. As a result, it is not necessary to provide an exception.

In lower seismic design categories, there are three proposed minimum requirements for the dowels:
- That they be sufficient to transfer any forces required for design
- That they equal or exceed the prescriptive reinforcement requirements for the masonry element, and
- That they be provide nominal tension capacity not less than the combined weight of the wall in the story above the foundation and the foundation, but that this need not exceed 3,000 pounds.

The first requirement is just a basic principle of design.

The second requirement follows the spirit of ACI 318 Section 16.3.4.2 that requires the area of reinforcement crossing the interface between the wall and foundation satisfy the minimum prescriptive wall reinforcement. For Grade 60 reinforcement, #5 or smaller, the minimum reinforcement ratio required for concrete walls is 0.0012. For an 8” concrete wall, this equates to roughly #4 @ 21”, or more than twice as many minimum dowels as would be required for a special reinforced masonry shear wall (#4 @ 48”) of any thickness.

The first two requirements may result no dowels or very few dowels being required, such that the goal of providing minimal structural integrity might not be achieved. The third requirement meets the intent of providing minimum structural integrity by extending the minimum tension ties required by the IBC for masonry bearing walls through the foundation. In a catastrophic event, these tension ties are intended to be able to support one level of the wall and the structure below the wall. The IBC provision reads as follows:

> **1616.3.2.4 Vertical ties.**
> Vertical ties shall consist of continuous or spliced reinforcing, continuous or spliced members, wall sheathing or other engineered systems. Vertical tension ties shall be provided in bearing walls and shall be continuous over the height of the building. The minimum nominal tensile strength for vertical ties wityhin a bearing wall shall be equal to the weight of the wall within that story plus the weight of the

diaphragm tributary to the wall in the story below. Not fewer than two ties shall be provided for each wall. The strength of each tie need not exceed 3,000 pounds per foot (450 kN/m) of wall tributary to the tie for walls of concrete or masonry construction or 750 pounds per foot (140 kN/m) of wall tributary to the tie for walls of cold-formed steel light frame construction.

Two other alternatives were considered for this third, structural integrity requirement.

In the first version of this ballot (20-SL-24), the provision was based on Section 6.1.10.2 of TMS 402 which requires at least 25 percent of the positive moment reinforcement in participating walls be extended into the support and anchored to develop the yield strength of the reinforcement. Section 6.1.10.2 is not proposed to be modified and some parties will continue to interpret that it applies where walls are supported by foundations. As a future business item, it is noted that Section 6.1.10.2 needs to be clarified (what is positive reinforcement in a wall?) and reconciled with these minimum dowel provisions, should they pass. We dropped the proposal base dowel provisions on Section 6.1.10.2 based on feedback from voters on the previous ballot objecting to both the volume of reinforcing this would require and the development of that reinforcing for its yield strength. For reference, that provision read as follows:

> **6.1.10.2** *Development of positive moment reinforcement* — When a wall or other flexural member is part of the lateral-force-resisting system, at least 25 percent of the positive moment reinforcement shall extend into the support and be anchored to develop the yield strength of the reinforcement in tension.

The other alternative considered was to develop a provision based on ASCE 7 Section 1.4.4:

> **1.4.4 Anchorage of Structural Walls.** Walls that provide vertical load bearing or lateral shear resistance for a portion of the structure shall be anchored to the roof and all floors and members that provide lateral support for the wall or that are supported by the wall. The anchorage shall provide a direct connection between the walls and the roof or floor construction. The connections shall be capable of resisting a strength level horizontal force perpendicular to the plane of the wall equal to 0.2 times the weight of the wall tributary to the connection, but not less 5 psf (0.24 kN/m^2).

The problem with this provision is that TMS 402 does not have a method for calculating the strength provided by dowels in the out-of-plane direction; the shear friction provision is applicable in the in-plane direction only. If the shear friction provision was used in spite of that limitation, it would then be required to develop the reinforcement for yield which was objectionable to some voters. An adjustment might also need to be made to the shear friction provision to eliminate the axial load term, since ASCE 7 requires that the prescribed forces be resisted by connections or anchors – and not by reliance on friction from gravity loads.

Embedment of Dowels into Foundation

In high seismic regions, it is necessary that the dowels be developed for their yield strength in order to ensure that the intended ductile behavior is achieved. It is also consistent with the requirement in ACI 318 that requires development for yield strength for reinforcement resisting seismic loads in the seismic-force-resisting system in these seismic design categories.

The previous ballot also required development for yield for dowels in lower seismic design categories for consistency with TMS 402 6.1.10.2 and top provide a degree of ductility compatible with the intent of the ASCE 7 structural integrity provisions. That ballot also argued that this would not affect foundation sizes and would not otherwise be onerous. In discussing the requirement to develop the dowels for yield with the negative voters, one of the negative voters also expressed concern about their ability to comply with that provision in situations where post-installed dowels were required, which we found to be a persuasive argument that could not be addressed during this code cycle.

As a result, it was decided to adapt the IBC structural integrity provisions which would result in a design tension load on the dowels that could then be used to design cast-in or post-installed dowels. While potentially providing less ductility than developing the dowels for yield, this will still be an important step forward for TMS 402 in addressing structural integrity.

Splicing of Dowels with Vertical Reinforcement

The provisions propose that all foundation dowels be spliced with the vertical wall reinforcement. These splices could be lap splices, mechanical splices, or welded splices, subject to the existing limitations of TMS 402.

In high seismic regions, it is necessary that the dowels be spliced with the vertical wall reinforcement in order to ensure that the intended ductile behavior is achieved.

In lower seismic regions, splicing the dowels with the vertical bars in necessary to achieve the continuous vertical ties sought by the IBC.

Response to Comments on Previous Ballot (20-SL-24):

Robinson Affirmative with Comment

> *I still think the exception to the requirements of Section 7.4.4.2.1 should indicate the requirements of Section 7.4.1.2.1 apply. Section 7.4.4.2 replace the requirements of Section 7.4.1.2.1, so it could be read that if the exception is used, no dowels are required. I think the exception should read "Exception: Only compliance with Section 7.4.1.2.1 is required if there is no tension at the wall to foundation interface when in-plane forces at the interface are evaluated using R not greater than 1.5."*
>
> *In the commentary to Section 7.4.4.2.1, Seismic Design Category C is referenced even though this section is for Seismic Design Category D and above.*

Commentary has been added to remind the user that SDC A requirements are still in effect should a wall in SDC D+ qualify for the exception.

Scott Affirmative with Comment

> *Consider leaving the decision to use foundation dowels up to the SEOR.*

The provision of minimum dowels for structural integrity should not be discretionary.

McGinley Negative

> *I generally believe that requiring dowels at the base of walls are a good goal. However, many walls (participating or otherwise) in lower seismic design categories (and loads) have relatively large amounts of vertical reinforcing for out of plane wind loading, especially if tall. The way I read your proposed change I would have to provide 25% of the wind bar area in the dowels (out-of-plane) into the foundation this seems excessive. I agree that dowels may be needed even in low seismic design conditions, but this should only be a small amount of rebar, especially where you would have only a small amounts of developed base bars for in-plane loading. I would happy to withdraw my negative if I have misinterpreted these new provsions.*
>
> *Futhermore: (not related to my main concern but comments)*

1. Much the rationale used relates to concrete beam and slab connections (these do need contniuty to develop resistance and ensure against collapse). The base of masonry walls do not need this same protection or continuity. If the shear wall can slide and large energy dissipation occurs (in plane).

2. What about the top of the wall? I would be supportive of requiring a minimum uplift at the wall bond beam and wall foundation interface related to typical wind uplift forces. I think this would get to where you want to be with dowels and address a bigger concern in my mind.

After discussion with the negative voters it was decided to replace the requirement to provide 25% of the reinforcing area, which was based on TMS 402 6.1.10.2, with a minimum tension force based on IBC 1616.3.2.4. See rationale statement above.

We offer the following response to the other two comments:

1. Since this ballot moves away from the approach based on TMS 402 6.1.10.2, this comment no longer needs to be addressed.
2. We agree that this should be addressed, but is beyond the scope of the public comment. This is included in the list of potential new business for next cycle. In the interim, the structural integrity requirements for masonry walls in IBC Section 1616 will provide a measure of protection for this condition.

Pierson Negative

I agree that this can be looked at next cycle, and I agree that you have identified a lot of issues to be considered.

I have a real problem with requiring all of these dowels to be fully developed for f_y, as the proposed provision requires. I agree that this might be required for hooked dowels, but we want that to be blamed on ACI rather than on TMS - so I think we should leave it alone.

If we require anchorage into the concrete element below, then we should just drop it there - the engineer needs to go to ACI to complete the design, and it is out of our hands. We simply state that the dowels must be adequately anchored into concrete footings or foundations. I don't see why we should specify that the development into the foundation element must be for the yield strength. Straight dowels still get the $A_{srequired}/A_{sprovided}$ reduction and hooked dowels don't (ACI 25.4.10.1) - but that is ACI, not TMS.

Bottom line - In my opinion it is better not to do this rather than have this provision in for an entire cycle before we figure out the right solution. As I have stated in earlier votes on this topic, the truth is that wall-to-foundation connections are required per Section 4.1.1, and both IBC and ASCE 7 have similar requirements.

We have removed the requirement to develop the minimum dowels for yield, replaced it with a reference to anchorage, and provided a demand that can be used to determine an appropriate development length. We have added commentary to explain the benefits to structural integrity of developing the dowels for yield.

As discussed above, the avoidance of the need to develop dowels for yield also influenced the decision to base the minimum reinforcement provisions on the IBC structural integrity provisions rather than the ASCE 7 provisions.

Ensuring the masonry structures have minimal connection to their foundations is too important of an issue to defer for another cycle. This is also an important first step towards TMS 402 talking control of and responsibility for the structural integrity of masonry structures, which is currently being addressed by the IBC.

Biggs Negative

Thanks for the considerable effort that went into this ballot.

I agree with the concept of addressing participating elements.

One of my concerns comes with 7.4.1.2.1: Item c) deals with what vertical bars are "provided". So, if the "design" requires prescriptive reinforcement at say 120" yet the engineer details bars at 48", the engineer is then required to include dowel area based upon the "provided" bars even though the number of vertical bars are a choice, not a design requirement.

Additionally, there is no provision for spacing of the dowels. Therefore, if #6 vertical bars are placed at 48" oc, #6 dowels can be placed at 192" oc and meet the provision. Does that really add resiliency?

I suggest deleting c).

The second concern is with 7.4.4.2.1 item a). It seems excessive for all cases since it makes no distinction between whether the flexural shear reinforcement is distributed over the wall length or concentrated at the ends (trim steel). If the trim steel provides the tension reinforcement, those bars are already required to be developed by code. The remaining vertical steel does not have to be developed for flexural tension. In that case, why can't the 25% rule from 7.4.1.2.1c) be used?

What if boundary elements are used?

I suggest editing the proposal for walls designed with either trim steel and boundary elements.

The requirement to provide 25% of the reinforcing area, which was based on TMS 402 6.1.10.2, has been deleted at the suggestion of the commenter. It has been replaced with a minimum tension force based on IBC 1616.3.2.4.

The maximum spacing would have to meet the maximum spacing for prescriptive reinforcement spacing per (b). Part (c) will also ensure that enough dowels are provided to at least be consistent with the structural integrity requirements of the IBC.

Relative to 7.4.4.2.1 (a), while from a design perspective one could elect to account for only some the vertical reinforcement as resisting in-plane flexure, from a behavioral perspective, providing dowels for only some of the reinforcement would concentrate inelastic behavior at base of the wall. As noted in the rationale “If the dowels do not match the wall reinforcement at the base of the wall, the inelastic behavior will be concentrated at the interface which may result in tensile rupture of the reinforcement rather than ductile yielding.”

Boundary elements aren’t required for structural integrity, so they do not directly bear on this ballot. However, it is interesting to note that the confinement for boundary zones of concrete shear walls is required to extend into the foundation. Whether this should be considered for masonry boundary zones is a topic that may warrant consideration next code cycle and has been added to the list of potential future business items at the close of this ballot.

Future Business

In preparing this ballot, a number of items were noted that may warrant consideration by the committee for the next cycle. These include the following:

- Mandating minimum dowels at all structural walls, even those not requiring prescriptive reinforcement, consistent with the ASCE 7 requirements to provide minimum anchorage or connection between structural masonry walls and supporting members.
- To achieve general structural integrity, should all structural masonry walls be required to have prescriptive reinforcement?
- Should there be a minimum dowel / anchorage / connection requirement for non-participating walls, either in high seismic regions or in all regions?
- How should out-of-plane force transfer be evaluated at the interface of walls and foundations? Can the shear friction provisions be used? In some cases, would it be preferable to a have a shear dowel provision which did not require that the tensile yield strength of the dowels be developed?
- Should requirements for post-installed foundation dowels be addressed? (While this is a concrete code issue, we could consider providing a minimum force per foot as alternate, like ACI requires 3000 lbs/foot vertical integrity ties in precast walls.)
- Should the provision be expanded to address other types of concrete supports such as concrete stem walls, concrete floor systems, and thickened slabs-on-grade?
- Are there interfaces between masonry elements and other materials that should be addressed to ensure that there are no gaps between TMS 402 and other codes?
- Generally review the code for current practice and peer codes with respect to integrity and resiliency.
- Clarify the intent of 6.1.10.2 – how is positive moment reinforcement intended to be understood in a wall? Where is this provision intended to apply?
- Resolve the apparent conflict between 6.1.10.1.3 and 6.1.10.2.
- Address effect of foundation restraint on out-of-plane wall design. Should we add provisions or commentary to Chapter 4 to address the effect of foundation restraint on out-of-plane wall design?
- Consider whether boundary zone confinement should continue some distance into the foundation.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown <u>underlined</u> and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

6.1.10.2 *Development of positive moment reinforcement* — When a wall or other flexural member is part of the lateral-force-resisting system, at least 25 percent of the positive moment reinforcement shall extend into the support and be anchored to develop the yield strength of the reinforcement in tension.

. . .

7.4.1 *Seismic Design Category A requirements*

. . .

7.4.1.1 *Design of nonparticipating elements*

. . .

7.4.1.2 Design *of participating elements* — Participating masonry elements shall be designed to comply with the requirements of Chapter 8, 9, 10, 11, or 12. Masonry shear walls shall be designed to comply with the requirements of Section 7.3.2.1, 7.3.2.2, 7.3.2.3, 7.3.2.4, 7.3.2.5, 7.3.2.6, 7.3.2.7, 7.3.2.8, 7.3.2.9, 7.3.2.10, or 7.3.2.11.

<u>7.4.1.2.1</u> *<u>Attachment to Foundation</u>* – <u>Dowels or continuous vertical reinforcement crossing the interface between the masonry and the supporting foundation shall be provided for masonry elements that are required to have minimum prescriptive vertical reinforcement. The provided area of steel crossing the interface shall equal or exceed the greater of the following:</u>

<u>(a) The area required for force transfer at the foundation interface,</u>

(b) The area required to meet the prescriptive vertical reinforcement requirements for the masonry element,
(c) For walls, sufficient area to develop a minimum nominal tension strength equal to the weight of the wall in the story above the foundation plus the weight of the foundation, but need not exceed 3,000 pounds per foot of wall tributary to the reinforcement. For allowable stress design, the nominal tension strength values provided above are permitted to be divided by 1.9 for comparison to the allowable tension stress in the reinforcement.
The reinforcement shall be anchored into the foundation. Where dowels are provided, the dowels shall be spliced with the vertical reinforcement in the masonry element. Where the dowels are a smaller size than the vertical reinforcement, the splice requirements may be determined based on the size of the dowel.

Renumber subsequent sections

7.4.4 *Seismic Design Category D requirements*

. . .

7.4.4.1 *Design of nonparticipating elements*

. . .

7.4.4.2 *Design of participating elements*

. . .

7.4.4.2.1 *Attachment to foundation* - Reinforcement crossing the interface between the participating masonry elements and the foundations shall be developed into the foundation for their yield strength, and shall be either continuous vertical reinforcement or dowels. Where used, dowels shall be spliced with the vertical reinforcement of the participating element and shall meet the following requirements:

(a) Wall dowels shall match the grade, size and spacing of the vertical wall reinforcement at the base of the wall.

(b) Column dowels matching the grade, size, and quantity of the vertical column reinforcement shall be provided for participating columns designed assuming a fixed-end condition at the foundation.

Exception: Compliance with this provision is not required in walls if there is no tension at the wall to foundation interface when in-plane forces at the interface are evaluated using R not greater than 1.5.

Renumber subsequent sections

Code Commentary:

6.1.10.2 *Development of positive moment reinforcement* — When a flexural member is part of the lateral-force-resisting system, loads greater than those anticipated in design may cause reversal of moment at supports. As a consequence, some positive reinforcement is required to be anchored into the support. This anchorage assures ductility of response in the event of serious overstress, such as from blast or earthquake. The use of more reinforcement at lower stresses is not sufficient. The full anchorage requirement need not be satisfied for reinforcement exceeding 25 percent of the total that is provided at the support.

. . .

7.4.1.2.1 *Attachment to foundation* – This provision is intended to provide a minimal connection between masonry members and the supporting foundations for the purpose of maintaining structural integrity in extreme events. As such, it is complementary to the requirements of Section 6.1.10.2, and the structural integrity provisions of ASCE 7 and the IBC. The structural integrity provisions of ASCE 7 and IBC may mandate the use of

reinforcement or other positive connections between structural masonry walls and foundations in excess of those required by this Code.

Part (c) is based on the required vertical ties in masonry bearing walls in the IBC and is intended to keep the wall and the foundation connected to each other in an extreme event. Since no ϕ is required for strength design by this provision, the 1.9 factor for allowable stress design is based on dividing the yield stress for Grade 60 reinforcement by the allowable tensile stress in Grade 60 reinforcement. The 3,000 pound per foot upper limit corresponds to a #4 (M#13) bar at 48 in. (1219 mm).

The anchorage of the reinforcement into the foundation should be consistent with the forces required for compliance with parts (a) and (c). Anchoring the reinforcement for their yield stress is desirable as it will provide enhanced ductility for extreme events, and is required by Sections 8.3.6 and 9.3.5.5 when shear friction is relied upon for force transfer.

Where the dowels are a smaller size than the vertical reinforcement, it is permitted to base the splice length on the size of the dowel as this will fully develop the capacity of the dowel at the foundation while maintaining continuity of reinforcement through the splice.

Unless the foundation is proportioned to restrain out-of-plane rotation, most foundations can accommodate sufficient rotation to approximate a pinned support. The presence of reinforcement crossing the interface does not necessitate treating conditions that would otherwise be approximated as pinned as having a degree of fixity.

Some contractors may find it desirable to provide additional dowels for improved safety or reduced external bracing of the wall during construction. Such additional dowels are generally not detrimental to wall performance and also improve resiliency.

. . .

7.4.4.2.1 *Attachment to foundation* – During a strong seismic event, inelastic behavior is expected at the wall-foundation interface. Yielding of reinforcement at this interface is a key contributor to achieving the higher R values required in Seismic Design Category C and higher. If, however, there is no tension at the interface assuming a nearly elastic R value, the behavior will not rely on yielding and compliance with this provision is not required. The minimum dowel requirements for Seismic Design Category A and higher in Section 7.4.1.2.1 would still be applicable.

While the designer may elect to rely on only some of the vertical reinforcing in determining the allowable load or nominal capacity of the wall, matching dowels are provided for all vertical reinforcement to avoid a concentration of ductility demands at the foundation interface. Such a concentration could result in the wall being unable to achieve the intended degree of ductility.

See commentary to Section 7.4.1.2.1 for discussion of out-of-plane restraint.

If additional dowels are proposed to be provided by the contractor as discussed in the commentary to Section 7.4.1.2.1, the increased flexural capacity may affect the shear capacity design of special reinforced masonry shear walls and mechanism limit states determined using the Appendix C provisions.

Specification:

None.

Specification Commentary:

None.

Subcommittee Vote:				
10 *Affirmative*	3 *Affirmative w/ comment*	1 *Negative*	0 *Abstain*	6 *Did not vote*

Subcommittee Comments:

A negative vote without a comment was recorded by Jobe.

The following affirmative with comment votes were received:

Lepage:

> *In the opening of Commentary to 7.4.4.2.1, consider replacing "is one of the first places" given that is not likely true in many coupled walls. How about using "During a strong seismic event, inelastic behavior is expected at the wall-foundation interface".*
>
> The suggested change has been made to this ballot.

Shing:

> *7.4.1.2.1(a): There is no guidance for calculating the area required for force transfer. Does that refer to the axial force as well as shear transfer? If they are required to transfer shear, then the frictional resistance will depend on the tensile yield strength of the dowels and the axial compressive force. Part (c) does not seem to guarantee that. I have the same concern for the Exception in 7.4.4.2.1(a). If we rely on the dowels for shear-friction, they have to be able to develop the yield strength. If these provisions are general and inclusive of shear walls under in-plane loading, they should be consistent with the shear-friction provisions in Chapters 8 and* 9.
>
> For Section 7.4.1.2.1, the commentary has been revised to emphasize that if shear friction is used for force transfer in part (a) that the dowels must be developed for yield into the foundation. Specifically, the highlighted text in the sentence below has been added in response to this comment:
>
> > Anchoring the dowels for their yield stress is desirable as it will provide enhanced ductility for extreme events, and is required by Sections 8.3.6 and 9.3.5.5 when shear friction is relied upon for force transfer.
>
> The reference to the exception in 7.4.4.2.1 (a) appears to have been intended for the exception in 7.4.4.2.2 (a). In that instance, commentary has already been provided to remind the user that if the exception is met that compliance with 7.4.4.2.1 is still required. Thus the highlighted phase above will also serve to remind the designer in this case that shear friction design requires development for yield strength.

Thompson:

> *As written, the continuity between the foundation dowels and the vertical wall reinforcement would be required to be accomplished by splicing. While I'm not a strong advocate of such details, I've seen some projects where the foundation reinforcement is continued uninterrupted into the walls to avoid splices altogether. I don't think we should prohibit this detail if one wanted to use it.*
>
> Agreed. The ballot has been reworded to reflect that either continuous reinforcement or dowels may be used to provide reinforcement crossing the interface.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SL-25	
Technical Contact/Email: John M. Hochwalt / john.hochwalt@kpff.com	
Public Comment Number: 2022 Comment # 63	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment:

Public Comment 63 read as follows:

> *There appear to be no provisions for the anchorage of deformed wire placed mortar and used as shear reinforcing. Can it be terminated with hook like joint reinforcing as illustrated in CC-6.1-4?*

Response/Rationale:

Ballot 20-RC-013 addressed changes in Chapter 6 necessary to address this comment. In an affirmative with comment vote on the ballot Corcoran made an observation that suggested a revision to Chapter 7 might be in order. Heather Sustersic, chair of the RC subciommittee forwarded to comment to the SL subcommittee for our consideration. The comment read as follows:

> *Seems like the 4" overlap figure shown in Figure CC-6.1-4 would provide better vertical Reinforcement confinement than the 3" wire extension figure. Is confinement a concern or a requirement?*

The 4” lap shown for joint reinforcement in Figure CC-6.1-4 is mandatory when joint reinforcement is used in special reinforced shear walls. Similarly, it should be made mandatory for deformed wire shear reinforcement in special walls.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

Note: The text below reflects changes made to this section through ballot 20-RC-013.

6.1.8 *Shear reinforcement*
Shear reinforcement shall extend to a distance d from the extreme compression face and shall be carried as close to the compression and tension surfaces of the member as cover requirements and the proximity of other reinforcement permit. Shear reinforcement shall be anchored at both ends for its calculated stress.

6.1.8.1 *Horizontal shear reinforcement* — Horizontal reinforcement shall meet the requirements of Sections 6.1.8.1.1 through 6.1.8.1.3.

6.1.8.1.1 Except at wall intersections, the ends of horizontal reinforcing bar or deformed wire embedded in grout shall be bent around the edge vertical reinforcing bar or deformed wire with a 180-degree standard hook.

6.1.8.1.2 At wall intersections, horizontal reinforcing bars or deformed wire embedded in grout shall be bent around the edge vertical reinforcing bar or deformed wire with a 90-degree standard hook and shall extend horizontally into the intersecting wall a minimum distance at least equal to the development length.

6.1.8.1.3 Deformed wire embedded in mortar and used as shear reinforcement shall be anchored by either:
(a) A 90-degree bend in longitudinal wires bent around the edge cell and with at least 3-in. (76-mm) bend extensions in mortar or grout, or
(b) A 90-degree bend in longitudinal wires bent around the edge cell and with at least 4-in. (102-mm) overlap of the wires in mortar or grout.

6.1.8.1.4 Joint reinforcement used as shear reinforcement shall be anchored around the edge reinforcing bar or deformed wire in the edge cell, either by placement of the vertical reinforcement between adjacent cross-wires or with a 90-degree bend in longitudinal wires bent around the edge cell and with at least 3-in. (76-mm) bend extensions in mortar or grout.

6.1.8.1.4.1 Where the joint reinforcement consists of two longitudinal wires, both of the wires shall be anchored by one of the following:
(a) Placement of the vertical reinforcement between adjacent cross-wires, or
(b) A 90-degree bend in longitudinal wires bent around the edge cell and with at least 3-in. (76-mm) bend extensions in mortar or grout, or
(c) A 90-degree bend in longitudinal wires bent around the edge cell and with at least 4-in. (102-mm) overlap of the wires in mortar or grout.

6.1.8.1.4.2 Where the joint reinforcement consists of four longitudinal wires, all four of the wires shall be anchored by either:
(a) A 90-degree bend in the inner longitudinal wires bent around the edge cell and with at least 3-in. (76-mm) bend extensions in mortar or grout, and a 3/16 in. (5 mm) U-stirrup lapped at least 8-in. (205-mm) with the outer wires, or
(b) A 90-degree bend in both the inner and outer longitudinal wires bent around the edge cell and with at least 4-in. (102-mm) overlap of the wires in mortar or grout.

. . .

7.3.2.5 *Special reinforced masonry shear walls* — Design of special reinforced masonry shear walls shall comply with the requirements of Section 8.3, Section 9.3, or Appendix C. Reinforcement detailing shall also comply with the requirements of Section 7.3.2.2.1 and the following:

. . .

(g) Joint reinforcement used as shear reinforcement shall be anchored in accordance with Section 6.1.8.1.~~4~~3.1 (a) or (c) when two longitudinal wires are used and Section 6.1.8.1.~~4~~3.2 when four

longitudinal wires are used. Deformed wire embedded in mortar and used as shear reinforcement shall be anchored in accordance with Section 6.1.8.1.3 (b).

Code Commentary:

Note: The text below reflects changes made to this section in ballots 19-SL-002.

7.3.2.5 *Special reinforced masonry shear walls*

. . .

(g) Option (a) in Section 6.1.8.1.3 and Option (b) in Section 6.1.8.1.4~~3~~.1 are~~is~~ excluded from use in special reinforced masonry shear walls due to lack of testing. Section 6.1.8.1 also addresses the anchorage of reinforcing bars and deformed wires placed in grout used as shear reinforcement in walls.

Specification:

None.

Specification Commentary:

None.

Subcommittee Vote:				
0 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments:

Robinson noted a typographical error in the commentary which has been corrected. When this was corrected, the order of section references in the commentary was incorrect and have been revised in this ballot.

In reviewing the ballot prior to submission to main, it was noted that the phrase “placed in grout” needed to be added to the last sentence of the commentary.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SM-PC17	
Technical Contact/Email: David L. Pierson, S.E. davep@arwengineers.com	
Public Comment Number: 2022 Comment # 17	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**
The response to Public Comment #17 has been balloted on Main Committee Ballot #20 (Item 20-SM-017). The item passed resulting in a sentence of commentary being added relative to the code requiring all beams to be reinforced. There was one negative, which was withdrawn, and 2 affirmative with comments. This ballot item is to address the issues that were brought up in the withdrawn negative and the comments.	

The comments were as follows:

From John Tawresey:

Comment: There are other reasons for reinforcing masonry beams.
Suggested language - All masonry beams are reinforced ~~to provide ductility.~~

From Dr. Richard Bennett:

Suggest an editorial revision to: Masonry beams are required to be reinforced to provide ductility.

From Tom Corcoran:
Suggest adding the words "strength and" to the proposed addition: All masonry beams are reinforced to provide "strength and" ductility.

Response/Rationale:

The intent of this added language in the Commentary was to reinforce the fact that the Code requires all beams to be reinforced. The language of the added sentence was not as clear as it should have been. The proposed language is much clearer in stating what we intend to state.

The modifications are based on the language that was approved in the ballot #20.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code: N/A

Code Commentary:

5.2 - Beams

All Masonry Beams are ~~reinforced to provide ductility~~ required to be reinforced to provide strength and ductility.

Specification: N/A

Specification Commentary: N/A

Subcommittee Vote:				
7 *Affirmative*	1 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	1 *Did not vote*

Subcommittee Comments: The affirmative comment was editorial and was taken into consideration in this version of the ballot.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SM-207	
Technical Contact/Email: Philippe Ledent (phil@masonryinfo.org)	
Public Comment Number: 2022 Comment # 207	
Public Comment Response Based on TMS 402/602 Draft Dated 6/1/2021	

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment #207: Use of the terms "collar joint", "grouted collar joint" and "mortared collar joint" are not used consistently or harmonized throughout this code.

Rationale: All references to collar joint (32 total) in the code are studied (see below the results of the analysis of use of these expressions). It seems clear that when, due to strength differences, mortared versus grouted modifiers are necessary, they are used with the identifiers of “mortared” and “grouted”. If it is a general refence to the joint between the wythes, just “collar joint” is used. Further, the definition of collar joint acknowledges “mortar or grout”. So, a general inconsistency or lack of harmonization is not found. However, one instance was found where “grouted collar joint” would be the better term instead of “collar joint” (Commentary to 6.1.3.2.5).

Code study on “Collar Joint” use consistency.

From Chapter 2- Definitions:

Collar Joint: Vertical longitudinal space between wythes of composite masonry that is filled with mortar or grout if unreinforced; and filled with grout if reinforced.

Rest of TMS402/602

- *32 total instances of “collar joint” including “mortared collar joint” & “grouted collar joint”.*
- *4 instances of Mortared collar joint*
    1. *Shear stress differentiating mortared from grouted – ASD (see below)*
    2. *Commentary to above*
    3. *Shear stress differentiating mortared from grouted – SD (see below)*
    4. *The referenced article titled “Shear capacity of mortared collar joints”*
- *9 instances of Grouted collar joint—most related to strength considerations*
    1. *3 instances in code and commentary in Chapter 3 related to QC “acceptance relative to strength”*
    2. *Chapter 6 stating rebars can be placed in grouted collar joints*
    3. *Chapter 6 commentary on use of welded wire reinforcement in grouted collar joints. Please also note that these seem to be newly edited sections.*
    4. *Remaining 4 are the same sections as mortared collar joints, differentiating one and the other specifically on test results/behavior differences observed, explaining why different strength values are attributed to each.*

- *19 instances of "collar joint"*
  - *#1- definition of collar joint*
  - *#2- definition of grout space, gross*
  - *#3,4,5,6, 7, 8 are in section 5.1.4 explaining multi-wythe masonry. One in figure.*
  - *#9 is in 5.5.-Corbels. taken out in a recent ballot.*
  - *#10 in Chapter 6, relates to reinforcement ratio/area.*
  - *#11 taken out with a recent ballot*
  - *#12-16: 5 instances in the shear stress section for ASD shown below to generally refer to the collar joints. The section differentiates mortared vs. grouted when appropriate, so no inconsistency detected here.*
  - *#17 in section 9.1.7.2. shear strength in composite masonry that mirrors ASD section below in Chapter 9. Collar joint (without modifiers of grouted or mortared) is general refence that is later explained as "grouted" or "mortared" as appropriate.*
  - *#18 in a referenced paper title*
  - *#19 in a referenced paper title*

8.1.4 *Shear stress in composite masonry*
8.1.4.1 Design of composite masonry shall meet the requirements of Section 5.1.4.2 and Section 8.1.4.2.
8.1.4.2 Shear stresses developed at the interfaces between wythes and collar joints or within headers shall not exceed the following:
(a) mortared collar joints, 7 psi (48.3 kPa).
(b) grouted collar joints, 13 psi (89.6 kPa).
(c) headers, 1.3 *fh* psi.

9.1.7 *Shear strength in composite masonry* **9.1.7** *Shear strength in composite masonry*
9.1.7.1 Design of composite masonry shall meet the requirements of Sections 5.1.4.2 and 9.1.7.2. The nominal shear strength is based on shear stresses that are twice the allowable shear stresses in allowable stress design. Commentary Section 8.1.4 provides additional information.
9.1.7.2 The nominal shear strength at the interfaces between wythes and collar joints or within headers shall be determined so that shear stresses shall not exceed the following:
(a) mortared collar joints, 14 psi (96.5 kPa).
(b) grouted collar joints, 26 psi (179.3 kPa).
(c) headers, 2.6 *fh* psi.

Proposed Changes:
Code: none
Commentary:
6.1.3.2.5 The limitations on maximum reinforcement percentage are based on the gross grout space presented by the cell, bond beam course, grouted collar joint, or AAC masonry core.

Subcommittee Vote:				
7 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	2 *Did not vote*

Subcommittee Comments:

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SM-21A	
Technical Contact/Email: Ece Erdogmus Ece.Erdogmus@design.gatech.edu	
Public Comment Number: 2022 Comment # 21	
Public Comment Response Based on TMS 402/602 Draft Dated 6/1/2021	
This ballot resolves a negative vote in Main Ballot 20 (20-SM-021).	

Rationale and Background:
The response to Public Comments #21 was balloted on Main Committee Ballot #20 (Item 20-SM-021). The response and associated changes to the Code passed but there was one negative comment. This ballot item is to address the issues that were brought up in the negative vote.

Negative comment by Dr. Richard Bennett:
I agree that the design criteria can be used with a single course. However, the public comment relates to the definition, which to me does not allow a single course because it says "successive courses." I would suggest revising the definition to: Corbel â€" A projection of a course or successive courses from the face of masonry.

This ballot asks to find Mr. Richard Bennett's negative persuasive. If this ballot passes, then Ballot 21-SM-21B will propose a new response to the Public Comment #21.

Original ballot (20-SM-021) language provided below for reference---
Public Comment #21: Can a corbel (see Section 2.2) be a single course? Consider revising definition/requirements to clarify.

20-SM-021 Response (Passed with no negatives and one affirmative with comment):
TMS 402, Section 2.2 defines a corbel as "*Corbel* — A projection of successive courses from the face of masonry."
TMS 402, Section 5.5 governs the design of corbels. Corbels can be either load bearing (Section 5.5.1) or non-loadbearing (Section 5.5.2).
Loadbearing corbels must be designed as reinforced (ASD, Strength or Prestress). Therefore, one course corbels are acceptable provided they are designed accordingly.
Non-loadbearing corbels can either be reinforced (ASD, Strength or Prestress) or detailed as noted in 5.5.2 and shown in Figures CC 5.5-1 or CC 5.5-2. As noted with the Loadbearing corbels, one course corbels are acceptable provided they are designed accordingly. In addition, one course corbels are acceptable when detailed per 5.5.2 and as shown by the commentary figures.
In short, given the design criteria already answers the question, **no change is proposed.**

Subcommittee Vote:									
7	*Affirmative*	1	*Affirmative w/ comment*	0	*Negative*	0	*Abstain*	1	*Did not vote*

Subcommittee Comments:

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SM-21B	
Technical Contact/Email: Ece.erdogmus@design.gatech.edu	
Public Comment Number: 2022 Comment # 21	
Public Comment Response Based on TMS 402/602 Draft Dated 6/1/2021	

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Rationale and Background:
The response to Public Comments #21 was balloted on Main Committee Ballot #20 (Item 20-SM-021). The response and associated changes to the Code passed but there was one negative. Ballot 21-SM-21A was to find this negative persuasive. Assuming that ballot will pass, this ballot item addresses the issues that were brought up in the negative vote.

Provided for reference---
Public Comment #21: Can a corbel (see Section 2.2) be a single course? Consider revising definition/requirements to clarify.

20-SM-021 Response (Passed with no negatives and one affirmative with comment):
TMS 402, Section 2.2 defines a corbel as "*Corbel* — A projection of successive courses from the face of masonry."
TMS 402, Section 5.5 governs the design of corbels. Corbels can be either load bearing (Section 5.5.1) or non-loadbearing (Section 5.5.2).
Loadbearing corbels must be designed as reinforced (ASD, Strength or Prestress). Therefore, one course corbels are acceptable provided they are designed accordingly.
Non-loadbearing corbels can either be reinforced (ASD, Strength or Prestress) or detailed as noted in 5.5.2 and shown in Figures CC 5.5-1 or CC 5.5-2. As noted with the Loadbearing corbels, one course corbels are acceptable provided they are designed accordingly. In addition, one course corbels are acceptable when detailed per 5.5.2 and as shown by the commentary figures.
In short, given the design criteria already answers the question, **no change is proposed.**

Negative comment by Dick Bennett:
I agree that the design criteria can be used with a single course. However, the public comment relates to the definition, which to me does not allow a single course because it says "successive courses." I would suggest revising the definition to: Corbel â€" A projection of a course or successive courses from the face of masonry.

This ballot is relevant if Ballot 21-SM-21A asking to Mr. Richard Bennett's negative persuasive.

Proposed Changes:
Revised response to Public Comment #21: Committee agrees with Public Comment, change is proposed

Section 2.2
Corbel — A projection of a course or successive courses from the face of masonry.

Subcommittee Vote:				
8 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	1 *Did not vote*

Subcommittee Comments:

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SM-PC23	
Technical Contact/Email: Ece Erdogmus Ece.erdogmus@design.gatech.edu	
Public Comment Number: 2022 Comment #23	
Public Comment Response Based on TMS 402/602 Draft Dated 6/1/2021	

This ballot item proposes the following response to the Public Comment:

☐ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☒ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment #23: Additional commentary may be helpful to define a concentrated load adjacent to an opening (see commentary to section 5.1.3 (b). Based on Figure CC-5.1-5 (c) is appears to be a load that is planar with the top of the opening. However, one can argue that the concentrated load in (b) is still adjacent to the opening. Stating explicitly in the commentary what adjacent means would be valuable.

Rationale* (to be included in Response)*: We agree with the commenter that there are issues to be addressed related to the definition of adjacent with respect to the application of concentrated loads in walls. The referenced papers in in the commentary of 5.1.3 (Arora, 1988 and Page & Shrive, 1987) do not specifically cover the wall opening locations as a parameter.

Response: Committee is unable to fully develop a response to Public Comment at this time, but propose further investigations in the next cycle.

Subcommittee Vote:				
8 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	1 *Did not vote*

Subcommittee Comments:

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SM-PC24	
Technical Contact/Email: Ece Erdogmus Ece.erdogmus@design.gatech.edu	
Public Comment Number: 2022 Comment #24	
Public Comment Response Based on TMS 402/602 Draft Dated 6/1/2021	

This ballot item proposes the following response to the Public Comment:

☐ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☒ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment #24: (see Figure CC-5.1-5) I see that the load distribution of 1 horizontal to 2 vertical is the same for a bond beam as it is for running bond. consider requiring the bond beam to be reinforced and then using a 1 horizontal to 1 vertical load distribution in the bond beam. This will help spread the load out in masonry walls.

Response: Committee disagrees with Public Comment and no changes are proposed

Rationale (to be included in Response): The Code requires all bond beams to be reinforced (see definition in Section 2.2.) Therefore, the first part of the comment is already satisfied by the code. Further, the commentary of 5.1.3 states that the two research studies from 1987 and 1988 (former on bond beams and the latter on walls) found little difference in dispersion and suggested using 2:1 for all systems for simplicity. (Language from commentary of 5.1.3 is provided below for reference.) There is no other/newer research on this topic (to the knowledge of the subcommittee members) that experimentally or analytically proves that a different load distribution ratio is appropriate to be suggested in the code for bond beams.

5.1.3 *Concentrated loads*

Arora (1988) reports the results of tests of a wide variety of specimens under concentrated loads, including AAC masonry, concrete block masonry, and clay brick masonry specimens. Arora (1988) suggests that a concentrated load can be distributed at a 2:1 slope, terminating at half the wall height. Tests on the load dispersion through a bond beam on top of hollow masonry reported in Page and Shrive (1987) resulted in an angle from the horizontal of 59 degrees for a 1-course CMU bond beam, 65 degrees for a 2-course CMU bond beam, and 58 degrees for a 2-course clay bond beam, or approximately a 2:1 slope. For simplicity in design, a 2:1 slope is used for all cases of load dispersion of a concentrated load.

Subcommittee Vote:				
4 *Affirmative*	2 *Affirmative w/ comment*	1 *Negative*	0 *Abstain*	2 *Did not vote*

Subcommittee Comments: A previous version of this ballot received a negative and two affirmative comments regarding the wording of the rational. The negative was found persuasive in a virtual subcommittee meeting and this version incorporates the changes requested by all of the comments.

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SM-PC25	
Technical Contact/Email:	Ece Erdogmus Ece.erdogmus@design.gatech.edu Adam Hutchinson, ahutchinson@nwcma.org
Public Comment Number:	2022 Comment # 136
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

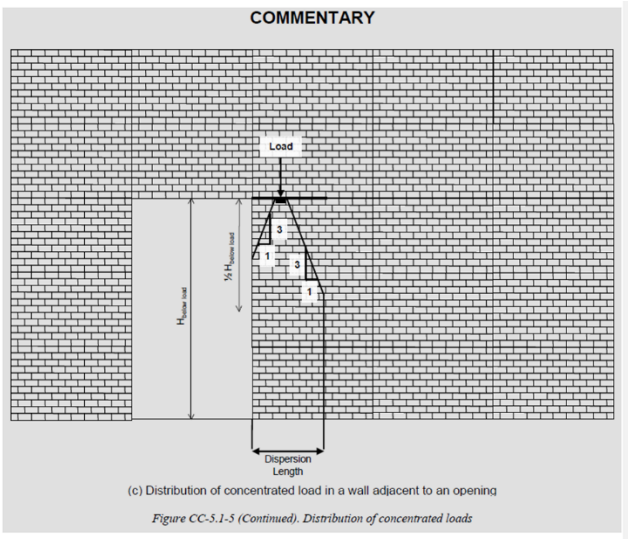
☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

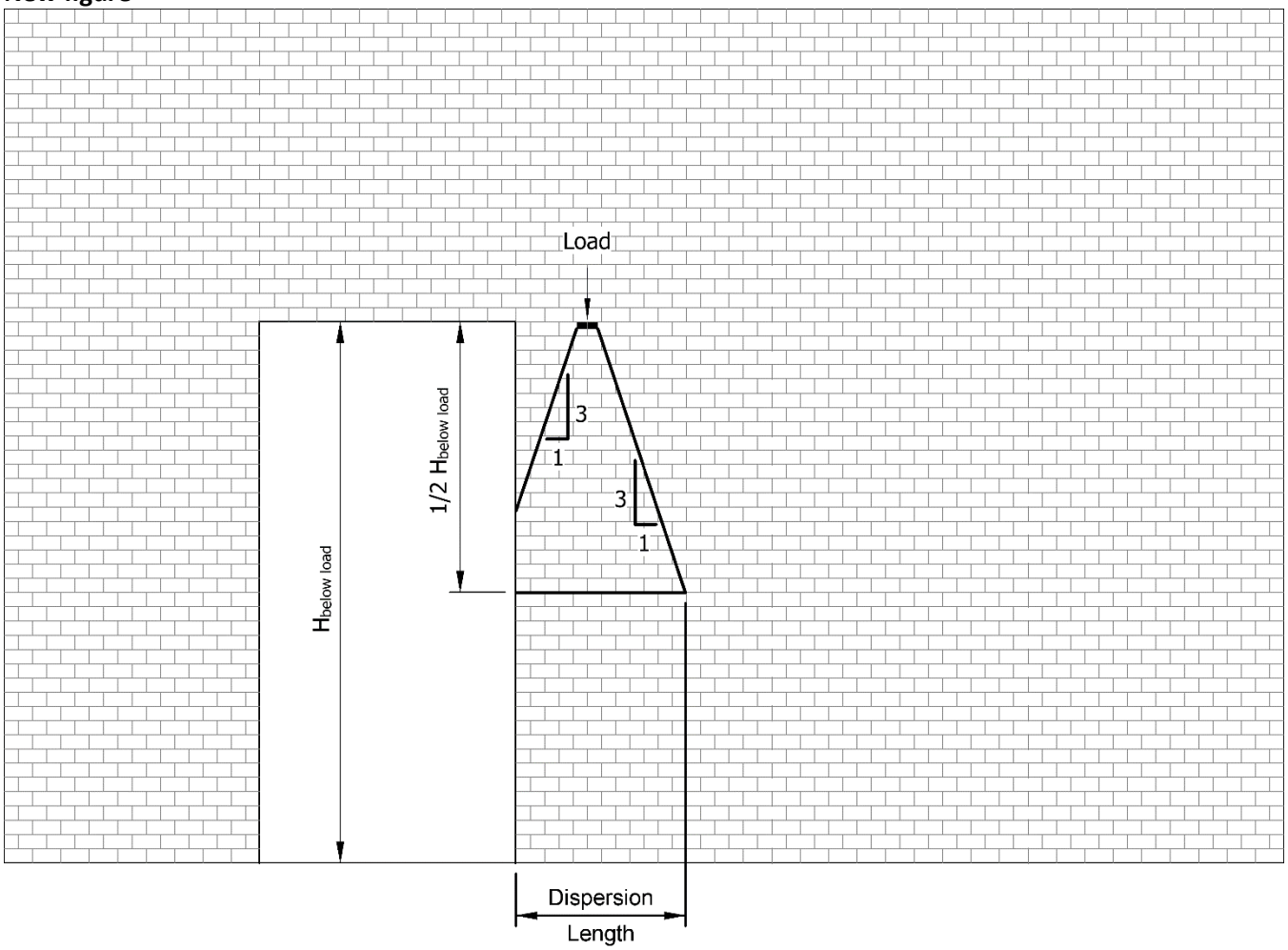
Public Comment #25: Code Commentary: Figure CC-5.1-5 (c)
In the figure, the load is not shown as dispersed to ½ H below load as depicted in the figure. That is, the end of the 3:1 line on the right-hand side does not terminate at the half-height point of the wall below the load. I count 14 courses of masonry above the termination and 19 courses of masonry below the termination. Consider changing the line termination so that it is at the mid-point of the height.

Response: *Committee agrees with Public Comment, changes to the figure are proposed*
(Please note that in addition to the change suggested by the commenter, the subcommittee noted stack bond depiction every several courses. The proposed figure also corrects this issue.)

Old figure



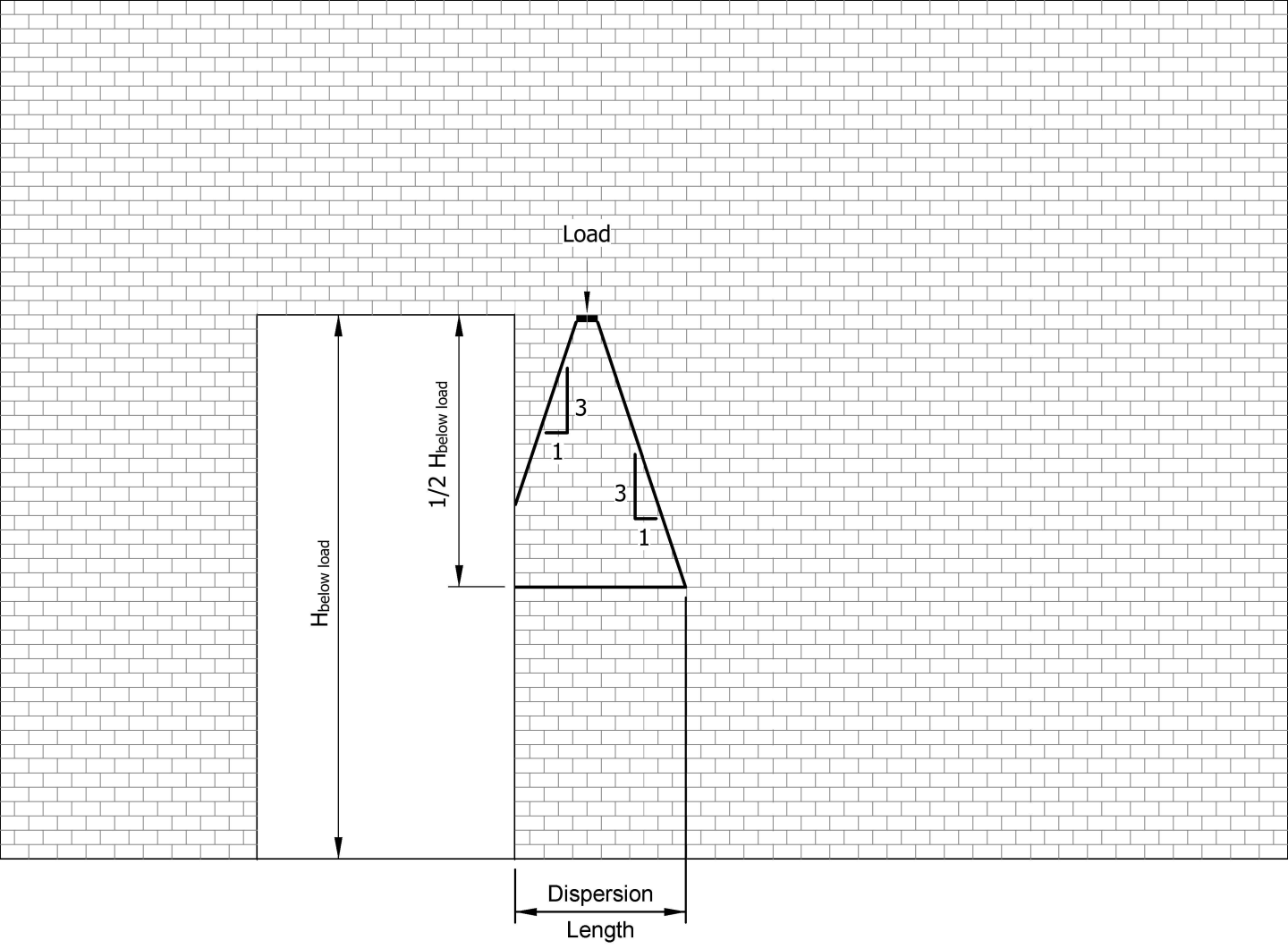
New figure



(c) Distribution of concentrated load in a wall adjacent to an opening

Subcommittee Vote:				
5 *Affirmative*	2 *Affirmative w/ comment*	1 *Negative*	0 *Abstain*	1 *Did not vote*

Subcommittee Comments: A previous version of this ballot/image received one negative and one affirmative comment. The negative was found persuasive in a virtual subcommittee meeting and this version incorporates the changes requested by all of the comments.



(c) Distribution of concentrated load in a wall adjacent to an opening

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SM-PC26	
Technical Contact/Email:	Heather Sustersic, hsustersic@colbycoengineering.com Adam Hutchinson, ahutchinson@nwcma.org
Public Comment Number:	2022 Comment # 26
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☐ ***Committee agrees with Public Comment, change is proposed***

☒ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment:

(see commentary to section 5.1.4.3.1, first paragraph) I do not understand the purpose of this sentence: "In non-composite masonry, the plane of the masonry is the plane of the space between wythes." Could we remove this sentence?

Also, the last sentence in this paragraph ("Loads due to...") is similar, but in poorer language, with Code Section 5.1.4.3.1-b. I suggest removing this sentence from commentary.

Response/Rationale:

The subcommittee agrees that the commentary language here is confusing. The first part of the public comment – deleting the sentence *"In non-composite masonry, the plane of the masonry is the plane of the space between wythes."* is proposed. However, the subcommittee disagrees with deleting the subsequent sentence, as it clarifies that two wythes do not equally share the load of a simply supported member that is capable of rotating about the pinned support, placing more force on the wythe closest to the center span of the member.

A figure is proposed to supplement the commentary text.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

None

Code Commentary:

5.1.4.3.1 Weak-axis bending moments caused by either gravity loads or lateral loads are assumed to be distributed to each wythe in proportion to its relative stiffness. See Figure CC-5.1-9 for stress distribution in non-composite masonry. ~~In non-composite masonry, the plane of the masonry is the plane of the space between wythes.~~ Loads due to supported horizontal members are to be resisted by the wythe closest to center of span as a result of the deflection of the horizontal member and subsequent rotation at the support. See Figure CC-5.1-11.

In non-composite masonry, this Code limits the thickness of the cavity to 4.5 in. (114 mm) to assure adequate performance. If cavity width exceeds 4.5 in. (114 mm), the wall ties must be designed to resist the loads imposed upon them based on a rational analysis that takes into account buckling, tension, pullout, and load distribution.

The NCMA and Canadian Standards Association (NCMA TEK 12-1B (2011); CSA (2014)) have recommendations for use in the design of ties for masonry with wide cavities.

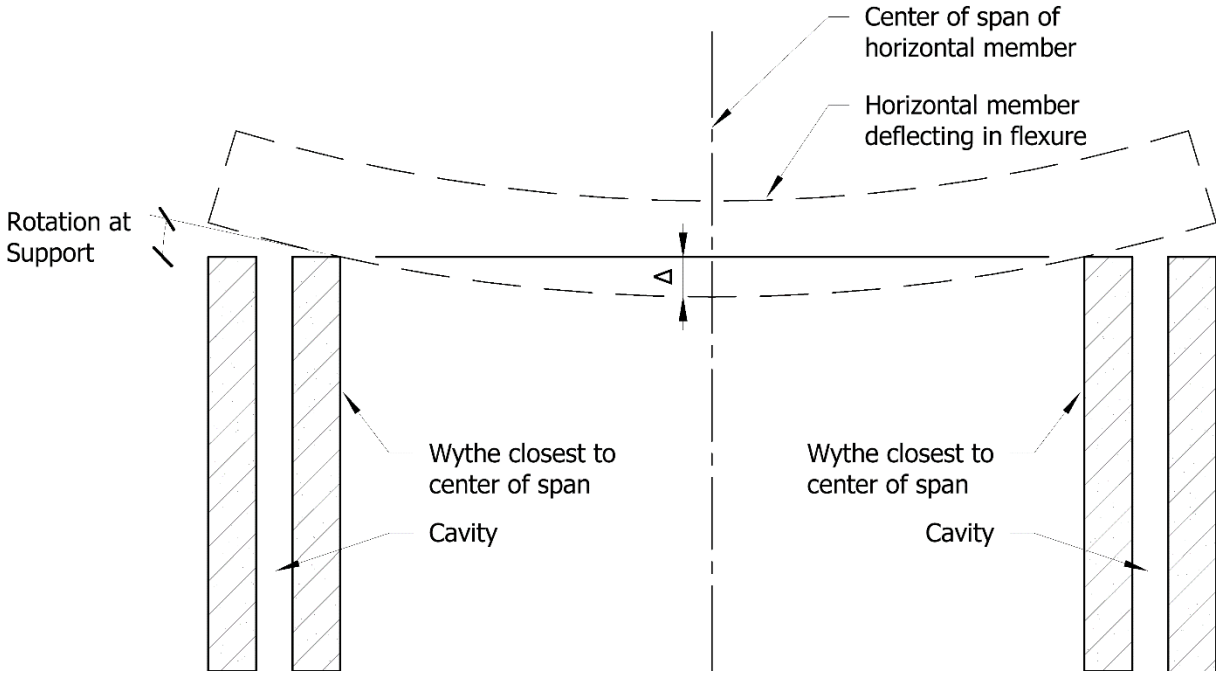


Figure CC-5.1-11 – Loading of inner wythe due to flexure in supported horizontal member.

Specification:

None

Specification Commentary:

None

Subcommittee Vote:				
6 *Affirmative*	1 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	2 *Did not vote*

Subcommittee Comments:

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SM-PC27	
Technical Contact/Email: Philippe Ledent (phil@masonryinfo.org)	
Public Comment Number: 2022 Comment # 27	
Public Comment Response Based on TMS 402/602 Draft Dated 6/1/2021	

This ballot item proposes the following response to the Public Comment:

☐ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☒ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

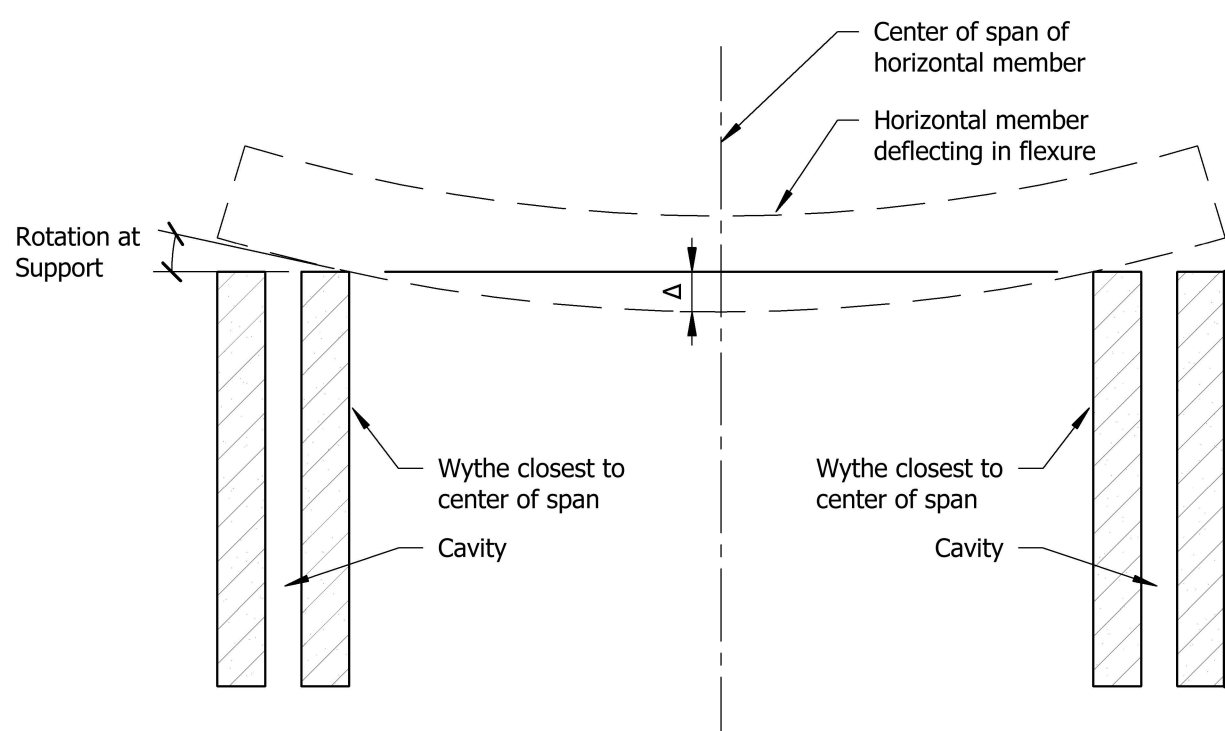
Public Comment #27: Provision 5.2.2.4 (a) is a little confusing given that the commentary states transverse (vertical?) shear reinforcement is not needed in deep beams.

Response: *Committee disagrees with Public Comment and no changes are proposed*

Rationale: (to be included in Response): The opening statement of 5.2.2.4 states "**when** shear reinforcement is required" and then it goes along to explain in the case that it is required, what are the requirements for this reinforcement in subsections (a), (b), and (c). The sentence in the commentary, on the other hand, states that deep beams do not *typically* need transverse reinforcement, citing a related research study. The subcommittee believes that the distinction between the words "when … required" in the code section, versus, "typically" in the commentary, removes a possible conflict or confusion.

Subcommittee Vote:				
7 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	2 *Did not vote*

Subcommittee Comments:


Center of span of horizontal member
Horizontal member deflecting in flexure
Rotation at Support
Δ
Wythe closest to center of span
Cavity
Wythe closest to center of span
Cavity

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SM-PC#28-29	
Technical Contact/Email: David L. Pierson, S.E. davep@arwengineers.com	
Public Comment Number: 2022 Comment # 28 / #29	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

The response to Public Comments #28 and 29 was balloted on Main Committee Ballot #20 (Item 20-SM-028/029). The response and associated changes to the Code passed with no negatives, but with one affirmative with comment. This ballot item is to address the issues that were brought up in the comment.

The comment was as follows:

From John Hochwalt:

> I'm not confident it will be obvious to all users that the intent is that the 50 psi limit be checked considering any eccentricity that is present, given that the 2000 lb load applies regardless of eccentricity. It seems like it would be prudent to add some commentary about how the 50 psi limit should be checked.

Response/Rationale:

The Ballot item passed, and so the 50 psi option is now part of the code for lightly loaded columns. This ballot item proposes to include additional clarifying commentary at the end of the commentary for section 5.3.2.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code: N/A

Code Commentary:

5.3.2 – Lightly loaded columns

Masonry columns are often used to support roofs of carports, porches, sheds or similar light structures. These columns do not need to meet the detailing requirements of Section 5.3.1. The axial load limit of 2,000 pounds (8,900 N) was developed based on the flexural strength of a nominal 8 in. (203 mm) by 8 in. (203 mm) by 12 ft high (3.66 m) column with one No. 4 (M#13) reinforcing bar in the center and f'm of 1350 psi (9.31 MPa). An axial load of 2,000 pounds (8,900 N) at the edge of the member will result in a moment that is approximately equal to the nominal flexural strength of this member. Although the allowable pressure limit may result in a total load of up to 3000 pounds, the nature of uniform pressure means that the resultant occurs at the centroid of the pressure. Therefore, the resulting moment will be minor and the total stress on the column (including bending and axial stress) will be less than the total stress from a 2000 pound load applied at the edge of the section.

Specification: N/A

Specification Commentary: N/A

Subcommittee Vote:				
8 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	1 *Did not vote*

Subcommittee Comments:

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-SM-PC34	
Technical Contact/Email: Heather Sustersic, hsustersic@colbycoengineering.com	
Public Comment Number: 2022 Comment # 34	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

☒ ***Committee agrees with Public Comment, change is proposed***

☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***

☐ ***Committee disagrees with Public Comment and no changes are proposed***

☐ ***Committee unable to fully develop a response to Public Comment***

☐ ***Public Comment only requires a response, no change to document***

Public Comment:

The use of other than running bond (formerly known as stack bond) is allowed by TMS 402 for shear walls but appears to be forbidden by Section 5.1.1.1 at wall intersections. This seems inconsistent. Please consider revising 5.1.1.1 to read, "Masonry shall be in running bond or constructed of solid grouted open-end units.", or other language the committee feels could help clarify the use of other than running bond at intersections.

Response/Rationale:

The current code and commentary of Section 5.1.1 *Wall Intersections*, provides three options for connecting wall webs to wall flanges to provide composite action: 50% of the units interlocking at the intersection (5.1.1.1.5(a)), steel connectors (5.1.1.1.5(b)), *or* reinforced bond beams spaced at 48" on center (5.1.1.1.5(c)). All three methods are acceptable means of providing composite action between wall web and wall flange. See excerpt below.

When 5.1.1.1.5(b) or 5.1.1.1.5(c) are implemented, only the steel mechanical connector (b) or rebar (c) and grout cross the interface. There is a continuous vertical head joint at the intersecting plane. In effect, the web and flange walls are 'not laid in running bond' with respect to each other.

The commenter is correct that TMS 402 allows the use of masonry 'not laid in running bond' in special reinforced masonry shear walls that follow the detailing requirements of 7.3.2.5. These walls are permitted for use in all Seismic Design Categories.

TMS 402 Excerpt from Section 5.1:

5.1.1.1.5 The connection of intersecting walls and walls to pilasters shall conform to one of the following requirements:

(a) At least fifty percent of the masonry units at the interface shall interlock.

(b) Walls shall be anchored by steel connectors grouted into the wall and meeting the following requirements:

(1) Minimum size: $^1/_4$ in. x $1^1/_2$ in. x 28 in. (6.4 mm x 38.1 mm x 711 mm) including 2-in. (50.8-mm) long, 90-degree bend at each end to form a U or Z shape.

(2) Maximum spacing: 48 in. (1219 mm).

(c) Intersecting reinforced bond beams shall be provided at a maximum spacing of 48 in. (1219 mm) on center. The area of reinforcement in each bond beam shall not be less than 0.1 in.^{2} per ft (211 mm^2/m) multiplied by the vertical spacing of the bond beams in feet (meters). Reinforcement shall be developed on each side of the intersection.

5.1 — Masonry assemblies

5.1.1 *Wall intersections*

Wall intersections may be designed and detailed as fully composite walls, as laterally supported walls, or as structurally independent walls in accordance with Sections 5.1.1.1, 5.1.1.2, and 5.1.1.3. Acceptable methods of detailing laterally supported walls may include the use of mesh ties, joint reinforcement, or anchors capable of transferring lateral loads only at the interface of laterally supported walls.

Movement joints at structurally independent walls should be sized to prevent force transfer when the walls laterally deform.

Connections of webs to flanges of walls may be accomplished by running bond, metal connectors, or bond beams. Achieving stress transfer at a T intersection with running bond only is difficult. A running bond connection is shown in Figure CC-5.1-1 with a "T" geometry over their intersection.

The alternate method, using metal strap connectors, is shown in Figure CC-5.1-2. Bond beams, shown in Figure CC-5.1-3, are the third means of connecting webs to flanges.

When the flanges are connected at the intersection, they are required to be included in the design.

The effective width of the flange for compression and unreinforced masonry in flexural tension is based on shear-lag effects and is a traditional requirement. The effective

A search for experimental data related to intersecting wall provisions for stack bonded masonry produced the work of Corrêa, Moreira, and Ramalho (2009). They found that while wall/flange intersections formed with a running bond pattern demonstrated a vertical shear capacity along the intersection between web and flange of 167% more vertical shear load than their 'stack bonded' counterparts, those assemblies also displayed a brittle failure compared to the more ductile failure of the stack bonded specimens. Select figure excerpts from this paper are pasted below, for information. Specimens labeled "RB" refer to running bond per 5.1.1.1.5(a), those labeled "SBT" and "SBS" refer to stack bond.

Figure 3: Vertical interfaces: a) Running bond (RB); b) Stack bond connected by steel trusses (SBT); c) Stack bond connected by steel U-staples (SBS)

Table 7: Comparison of the 1rst crack load for the different third-scale specimens

Type of connection	1rst Crack Load (kN)	Ratio to RB
RB	40.17	1.00
SBT	36.50	0.91
SBS	37.00	0.92

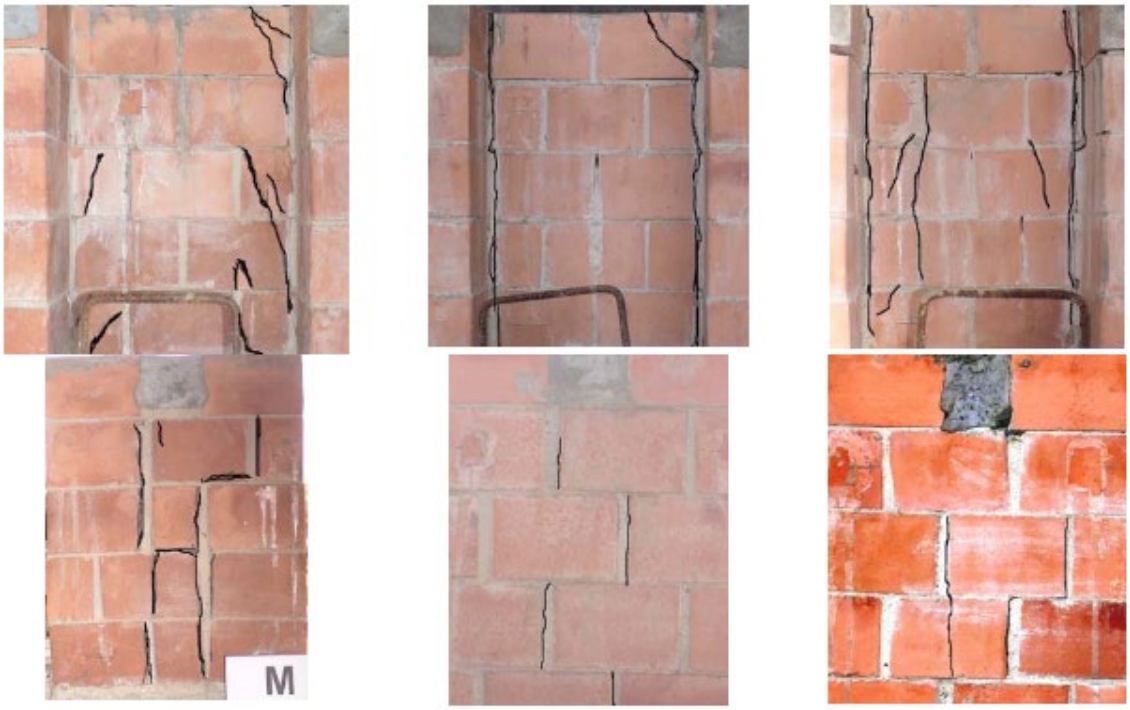


Figure 4: Comparison of typical failure patters: a) Running bond (RB); b) Stack bond connected by steel trusses (SBT); c) Stack bond connected by steel U-staples (SBS)

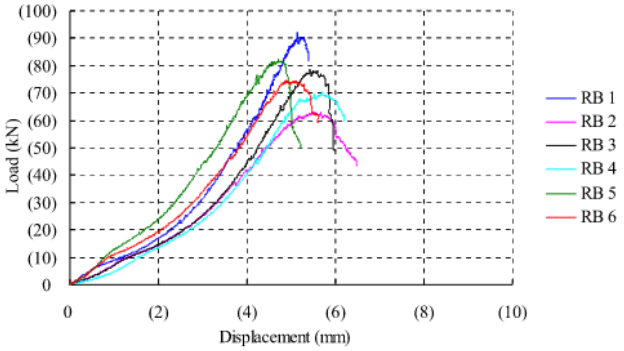


Figure 5: Diagram load-vertical displacement - RB specimens

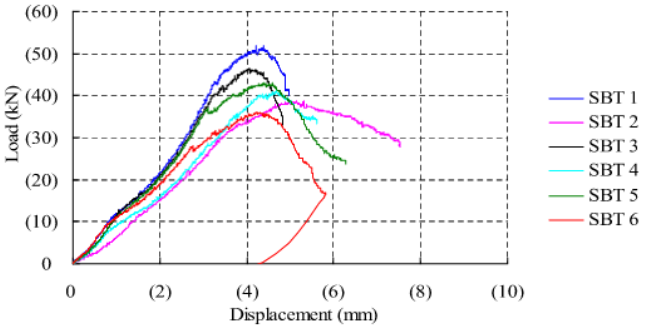


Figure 6: Diagram load-vertical displacement - SBT specimens

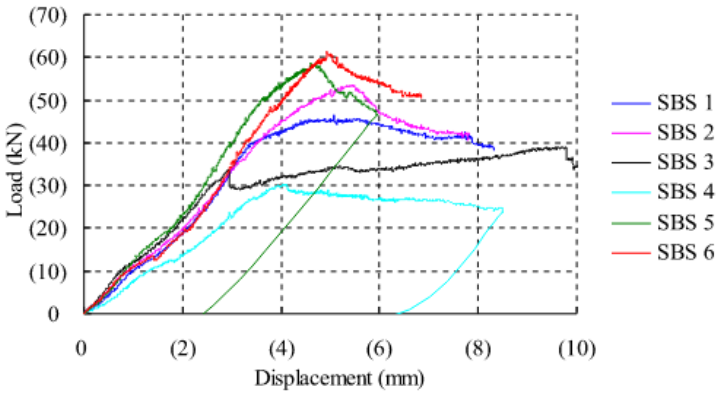


Figure 7: Diagram load-vertical displacement - SBS specimens

Suggested Future Business:

Section 5.1.1.1.5(b) is limited to steel connectors bent in a U- or Z- shape with specified minimum dimensions. Given the test results summarized above, it may be appropriate to permit other connector types to provide composite action between wall webs and wall flanges. It is recommended that during the next cycle the committee consider amending 5.1.1.1.5(b) to allow alternate connectors, such as the steel staples and flat mesh 'trusses' depicted in the inserted Figure 3 above, or other innovative solutions, to be used to provide composite action.

Reference Citation:

Corrêa, M. R. S., E. M. S. Moreira, and M. A. Ramalho. "Experimental small-scale analysis of the connections between structural clay block work masonry walls submitted to vertical loads." *11th Canadian Masonry Symposium*. 2009.

Note: Another ballot 20-SM-PC22-A that reorganizes the section passed, therefore this content will be located in the proposed new section 5.2.3.1 after reorganization and will reference 5.2.3.5(c).

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

5.1.1.1 *Design of masonry wall and pilaster intersections for composite action*

5.1.1.1.1 Masonry shall be laid in running bond or shall meet the requirements of 5.1.1.1.5(c).

5.4 – Pilasters

5.4.1 Walls interfacing with projecting pilasters shall not be considered as flanges, unless placed in running bond and the construction requirements of ~~5.1.1.1.1 and~~ 5.1.1.1.5 are met. When these construction requirements are met, the projecting pilaster's flanges shall be designed in accordance with Sections 5.1.1.1.2 through 5.1.1.1.4.

Code Commentary:

None

Specification:

None

Specification Commentary:

None

Subcommittee Vote:				
5 *Affirmative*	2 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	2 *Did not vote*

Subcommittee Comments: The comments made in the subcommittee ballot are taken into account in this version of the ballot.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-014-015		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 14 and 15		
This ballot item proposes the following response to the Public Comment:		
☐	Committee agrees with public comment, change is proposed	
☒	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☐	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comments:

14 – Per Footnote 6, this table has fastener type with withdrawal strength and lateral strength given.

a. There is no reference for the source of these values.
b. The values are not for masonry and should not be in the masonry standard.
c. Users should be directed to the wood industry standards (NDS) to obtain the values.
d. The commentary (13.3.2.5 e) indicates that the tables do not address wet service conditions. Wet service conditions can greatly reduce strength values.
e. The only material limitation given in the footnotes is on wood specific gravity. All the limitations on the table should be with the table and not solely in the commentary.

Remove the table and reference NDS standards. *[Page 246, Line 1; Table 13.3.2.5]*

15 – The source of the strength values in this table are not provided. The table should not be in the masonry standard. The strength values were not developed by the committee. Remove the table and refer to the industry document from which the values were obtained. *[Page 247, Line 1; Table 13.3.2.5 & 13.3.2.6]*

Response:

Directing users to the NDS would be of little help as the NDS does not contain the appropriate design properties. The NDS only addresses withdrawal and shear strength of fasteners that are fully embedded. All fasteners within Table 13.3.2.5 are assumed to be partially embedded with a protrusion length equal to the maximum cavity thickness specified. In actual construction the cavity will be filled with some material (sheathing, insulation, drainage mat, etc.) that may or may not contribute to the withdrawal and lateral strength of the fastener – but because it is unknown what these cavity materials will be, their contribution to the strength of the fastening system is conservatively neglected.

There are essentially two parts to Table 13.3.2.5 in application:
1) There are the prescriptive fastener options. For example, if a veneer assembly weighs 30 psf or less and fasteners are installed at a spacing of no more than 6.5 inches, then a 6d common nail will comply. This is no different than past editions of TMS 402. From the 2016 edition, Section 12.2.2.6.3 stipulates the use of an 8d common nail (or equivalent); Section 12.2.2.11.2.3 requires the use of a ring-shank nail or No. 10 screw; etc.
2) The second way of applying Table 13.3.2.5 is to use the equivalent faster strength values. From the previous example, if one did not want to use a 6d nail, they could choose a different fastener that provided at least 140 lb of withdrawal strength and 60 lb of lateral strength. These values are completely independent of any material as it does

not matter what the fastener is being embedded into or what the fastener type is. They are simply design loads that are intended to be more useful to the user that the historical reference of 'or equivalent'.

The lateral and withdrawal strength of a fastener embedded in wood are dependent on three variables: the specific gravity of the wood, the diameter of the fastener, and the length of penetration into the substrate. If using the prescriptive option and selecting a nail type from Table 13.3.2.5, each of these properties is defined within the Table. Footnote 5 defines the minimum specific gravity for the wood. The selection of a given fastener defines the diameter and fastener length and the length of penetration is taken equal to the fastener length minus the maximum cavity thickness.

Section 13.1.2.1 requires all masonry veneers to comply with the weather protection requirements of the adopted building code. Doing so would preclude the use of wood frame construction subjected to wet service conditions. The commenter is correct that wet service conditions would reduce the fastener strength in wood construction, but if all the requirements of Chapter 13 are met, these conditions would be avoided. This is a reasonable assumption as opposed to taking worse-case conditions across the board effectively dropping the fastener strength to zero.

The following changes are made to add more information to the commentary along with a reference.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown <u>underlined</u> and deletions are shown ~~struck-through~~.)*

Code: NONE

Code Commentary:

13.3.2.5 *General requirements*

……

(e) The critical load path when attaching an adhered veneer to light frame backing is through the fasteners used to install the lath over the backing. These fasteners are subjected to axial forces resulting from out-of-plane wind and seismic loads and lateral shearing forces from gravity and seismic loads. Tables 13.3.2.5 and 13.3.2.6 provide maximum fastener spacing requirements for common fastener types. Given the wide array of fastener types available, however, each table also provides a minimum withdrawal and lateral strength that must be satisfied where a different fastener is selected. These withdrawal and lateral strengths must account for the reduced embedment depth of the fastener due to nonstructural materials such as insulation within the assembly cavity. <u>Fasteners are assumed to be partially embedded into their substrate due to the presence of the cavity. The withdrawal and lateral strengths of partially embedded fasteners is derived from the Wood Handbook (FPL (2010)). Table 13.3.2.5 assumes a conservative specific gravity value of 0.40 for the wood light frame backing and no strength adjustments for loading duration, wet service conditions, or extreme temperatures.</u>

. . . .

….fasteners for vertical gravity loads, accounting for seismic, is often controlled by the flexural strength and stiffness of the fastener, particularly as the weight of the veneer assembly or thickness of the cavity increases. Therefore, common nails are specified because they have greater flexural strength and stiffness than other nail types. For both out-of-plane and gravity loads, conservative design values for the fastener withdrawal and shear strength were assumed accounting for the reduced fastener embedment depth due to the presence of sheathing, air space, insulation, or other materials within the cavity. ~~Table 13.3.2.5 assumes a conservative specific gravity value of 0.40 for the wood light frame backing and no strength adjustments for loading duration,~~

~~wet service conditions, or extreme temperatures.~~ Table 13.3.2.6 requires a backing of light steel framing having a minimum thickness of 16 gauge (1.5 mm) and a minimum yield strength of 50,000 psi (345 MPa) or larger. A more economical design could be achieved using the procedures of Section 13.3.3.

References, Chapter 13

FPL (2010), *Wood handbook - Wood as an engineering material*, General Technical Report FPL-GTR-190, U.S. Department of Agriculture, Forest Service, Forest Products Laboratory.

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
12 *Affirmative*	0 *Affirmative w/ comment*	1 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: The Negative was withdrawn at the VG Subcommittee Meeting on 2/10/2022. Changes were made to the ballot item based on the negative comments. The changes were approved by the voting members at the meeting and appear on this ballot item – vote 12, 0, 0.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-041-042-184		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 41, 42 and 184		
This ballot item proposes the following response to the Public Comment:		
☐	Committee agrees with public comment, change is proposed	
☒	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☐	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comments:

PC 41 – Note 1 of Table 13.3.2.5 defines the cavity as the space between the stud of the back of the veneer. This is in conflict with the definition of cavity in Chapter 2 which lists the cavity as from the backing to the inside face of the veneer. Please make Note 1 consistent with the definition. *[Page 247, Line 29; Table 13.3.2.5]*

PC 42 – Note 2 of Table 13.3.2.6 defines the cavity as the space between the stud of the back of the veneer. This is in conflict with the definition of cavity in Chapter 2 which lists the cavity as from the backing to the inside face of the veneer. Please make Note 1 [of Table 13.3.2.6] consistent with the definition. *[Page 247, Line 29; Table 13.3.2.6]*

PC 184 – A figure should be added to the commentary that shows the various terms used in Section 13.3.2.5 (e) such as cavity and what is considered as the veneer assembly. These terms are also used in Tables 13.3.2.5 and 13.3.2.6 and a figure could help explain how these occur in adhered veneer assembly. *[Page 245, Line 71; Commentary Section 13.3.2.5 (e)]*

Response:

The veneer for an adhered masonry veneer includes the setting bed and lath if used, so there is no discrepancy between the definition and the figure. See also the definition of adhered veneer:

> *Veneer, adhered — Masonry veneer secured to and supported by the backing through direct bond to a masonry or concrete backing; or bond to either a scratch coat and lath or a cement backer unit that is fastened to a masonry, concrete, or light frame backing.*

Fig. CC-13.2-4 provides a graphic description for <u>anchored</u> veneer, so a new figure (CC-13.3-1) is recommended to graphically show how the definition of cavity and veneer assembly is applied to <u>adhered</u> veneer.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown <u>underlined</u> and deletions are shown ~~struck-through~~.)*

Code: NONE

Code Commentary:

13.3 Adhered Veneer

. . . .

The designer should provide for proper means of bonding units to the backing, attachment of the lath and scratch coat or cement backer unit to the structure, control curvature of the backing, account for differential movement, consider freeze-thaw cycling, water penetration, air leakage, and vapor diffusion. There are proprietary systems that can demonstrate compliance with this section. Manufacturer documentation including submittals should be consulted and referenced as required in TMS 602 Article 1.5.

The cross-section of a typical adhered veneer wall where the backing is either wood or metal studs is shown in Figure CC-13.3-1.

13.3.2.5 *General requirements*

. . . .

(e) The critical load path when attaching an adhered veneer to light frame backing is through the fasteners used to install the lath over the backing. These fasteners are subjected to axial forces resulting from out-of-plane wind and seismic loads and lateral shearing forces from gravity and seismic loads. Tables 13.3.2.5 and 13.3.2.6 provide maximum fastener spacing requirements for common fastener types. Given the wide array of fastener types available, however, each table also provides a minimum withdrawal and lateral strength that must be satisfied where a different fastener is selected. These withdrawal and lateral strengths must account for the reduced embedment depth of the fastener due to nonstructural materials such as insulation within the assembly cavity. See Figure CC-13.3-1 for determination of cavity width.

[New figure]:

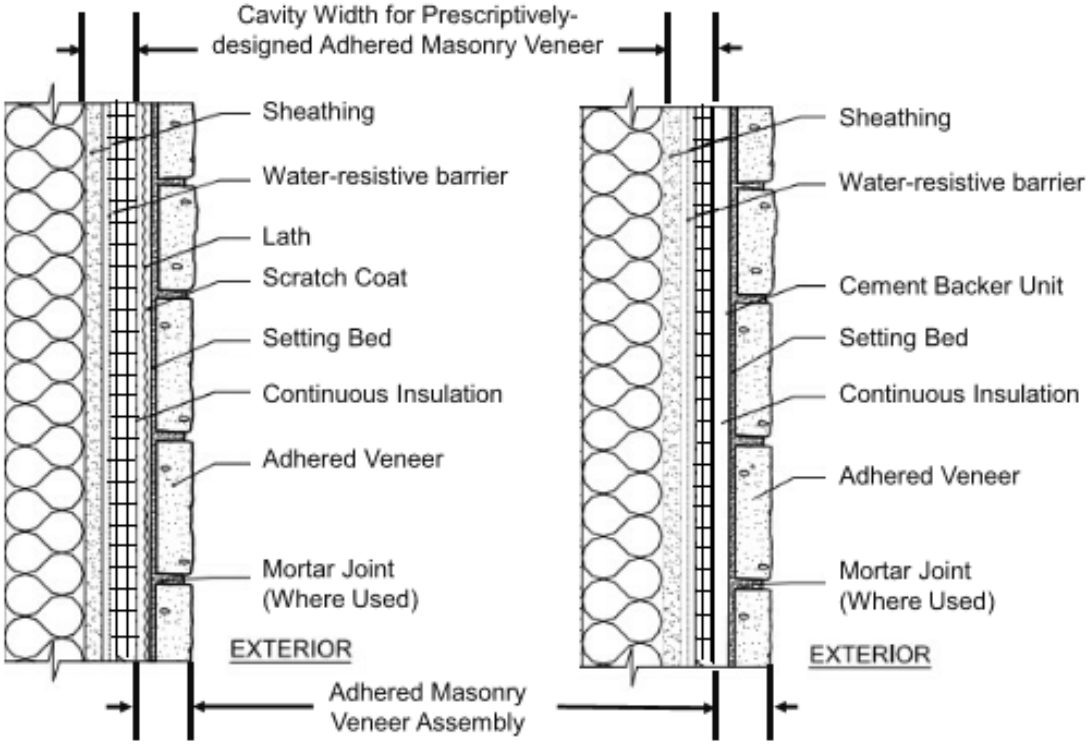


Figure CC-13.3-1 Cross-section of typical adhered masonry veneer supported by light frame

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:					
12 *Affirmative*	0 *Affirmative w/ comment*	1 *Negative*	0 *Abstain*	0 *Did not vote*	

Subcommittee Comments: The Negative was found persuasive at the VG Subcommittee Meeting on 2/10/2022 – Vote: 12, 0, 0. Changes were made to the ballot item based on the negative. The changes were approved by the voting members at the meeting and appear on this ballot item – vote 12, 0, 0.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-056A-067A		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 56 and 67		
This ballot item proposes the following response to the TAC comment:		
☐	Committee agrees with public comment, change is proposed	
☒	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☐	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comments:
67 – There are several uses of the term "backing" in the adhered veneer provisions that are inconsistent with the definition of backing in Section 2.2. Alternate terminology should be used at the following locations (noted as "page - line"): 242-66, 243-7, 243-54, 243-56, 243-30, 243-79, 248-56.

56 – By including concrete, masonry, and light frame in the definition of backing, the code is requiring the backing to be one of these types. However, the commentary for 13.2.2.3 states that there could be other backings. The definition of backing should be limited to: Structural wall or surface to which veneer is attached. The rest of the definition should be moved to the commentary.

Response: Changes are made consistent with public comment. Changes are made to the definition and then four uses of the term backing are changed.

This item was balloted as 20-VG-056-067 and did not receive any negatives; however, the comments resulted in proposed changes which are highlighted in yellow below. Other changes already approved are not shown for clarity.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code: NONE

Code Commentary:

13.3.2.1 *Permitted units* — The design strengths are based on bond between the unit and the mortar, and the backing and the mortar. The strength of other components in the system also needs to be considered. The strength could be controlled by ~~the backing, such as~~ a shear failure in a cement backer unit or elsewhere within other layers within the system.

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
12 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: None.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-059		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 059		
This ballot item proposes the following response to the Public Comment:		
☐	Committee agrees with public comment, change is proposed	
☐	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☐	Committee disagrees with public comment and no changes are proposed	
☒	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comment:
Section 13.2.3.1.1 provides deemed to comply strength and stiffness values for commonly available types of veneer ties. As stated in the commentary, these deemed to comply values are based on data from tie tests. While Table 13.2.2.4 provides minimum geometric requirements that the ties must meet to achieve the deemed-to-comply capacities, there are no minimum mechanical properties for tie materials. While TMS 602 Articles 2.5G and 2.5 I lists ASTM standards for tie materials, these ASTMs by themselves are insufficient to ensure that ties fabricated in accordance with the code and specification will achieve the listed deemed-to-comply capacities. Two examples of this are:

- Carbon steel sheet steel. ASTM A1008 allows yield strengths as low as 25 ksi. Based on Drysdale and Wilson (1989), the ties they tested had sheet steel yield strengths ranging from about 40 to 60 ksi.
- Stainless steel wire. The deemed-to-comply values do not distinguish between ties fabricated from carbon steel and those fabricated from stainless steel, although the mechanical properties of stainless steel are typically lower than those of carbon steel. For example, we understand that the ASTM A1064 carbon steel wire typically used in ties has a yield strength of around 80 ksi, whereas the typical ASTM A 580 stainless steel wire used in ties has a yield strength of around 45 ksi.

TMS 602 Articles 2.5 G and 2.5 I should be revised to specify minimum yield and tensile strengths for tie materials where the minimum strengths in the ASTM standard are insufficient to ensure that the ties will achieve the listed deemed-to-comply capacities . *[Page 238-239, line 27; Section 13.2.3.1]*

Response:

While stainless steel materials have different properties than carbon steel, the use of stainless steel veneer ties have performed similar to carbon steel veneer ties in the field. This experience is gleaned from hundreds of projects that have used stainless steel with no adverse effects due to the material that they are made from. In addition, stainless steel has a much longer life than a galvanized steel veneer tie which provides improved performance. Further research on this issue is needed and so it is proposed that this discussion continue into the next code cycle.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code: NONE

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
13 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: None

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-60B		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 60		
This ballot item proposes the following response to the Public Comment:		
☒	Committee agrees with public comment, change is proposed	
☐	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☐	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comment:
The definition of adhered veneer is unnecessarily restrictive on the types of backing that can be used to support cement backer units. I suggest striking the words "masonry, concrete, or light frame" and replacing them with "the.". *[Page 45, line 17; Section 2.2]*

Response: The committee agrees with the public comment and the change is made.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code:

2.2 – Definitions
Veneer, adhered — Masonry veneer secured to and supported by the backing through direct bond to a masonry or concrete backing; or bond to either a scratch coat and lath or a cement backer unit that is fastened to ~~a masonry, concrete, or light frame~~ the backing.

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
13 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: None

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-065B		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 65		
This ballot item proposes the following response to the Public Comment:		
☐	Committee agrees with public comment, change is proposed	
☒	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☐	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comment:
Table 13.2.2.3 lists prescriptive fasteners for the attachment of veneer anchors to the backing. There are a number of assumptions that were made in determining the size and embedment of these fasteners that are not documented in the table or in the commentary. In addition, while the capacity of the fasteners into the light frame backing can be determined from the NDS and AISI codes, the capacity of the fasteners into the concrete and masonry backing are not addressed by TMS or ACI. Rather the capacity of these fasteners are based on testing. In both cases, there is risk of the designer inadvertently specifying a fastener condition that has a lower capacity than intended by this table.

For fasteners into concrete and masonry backing, I suggest that compliance with 13.2.2.3.2 be required. This would place the responsibility on the designer [to] select an anchor based on published data. The same approach could be taken for the light frame backing, or the code and specification could provide additional detail so that the designer can specify fastener and backing materials that are consistent with the assumptions made in developing this table. *[Page 234, Line 1-33; Table 13.2.2.3]*

Response: There is no standard screw for masonry and concrete (such as there is a standard for nails) and each manufacturer makes their own screws. As recommended by the Public Comment, specific fasteners are deleted from concrete and masonry line items and just reference Section 13.2.2.3.2. The recommendation in the second paragraph will be taken up as new business during the next cycle.

Proposed editorial changes: Change heading in left hand column of Table 13.2.2.3 to "Cold-formed <u>Steel</u> Light Frame". Also, delete "corrosion resistant" in the right hand column of Cold-formed Steel Light Frame line since this requirement is not stated with the other backing types to be consistent. The second incidence of corrosion resistance refers to the stud.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown <u>underlined</u> and deletions are shown ~~struck-through~~.)*

Code:

Table 13.2.2.3 – General prescriptive anchored veneer requirements

Backing	Veneer Tie Type	Maximum Specified Cavity Width	Other requirements
Wood Light Frame	Corrugated Sheet-metal	1 in. (25.4 mm)	Fastener: Minimum 2.5 in. (63.5 mm) x 0.131 in. (3.33 mm) ring-shank nail(s) with minimum 1 3/8 in. (34.9 mm) penetration into backing or No. 10 screw(s) with 5/8 in. (15.9 mm) penetration into backing. Locate fastener within ½ in. (12.7 mm) of the 90-degree bend in the veneer tie. The limiting p_{veneer} values for prescriptive design method shall be 75 percent of those listed in Table 13.2.1.1. Corrugated ties shall not be used on veneers greater than 30 ft (9.14 mm), or 38 ft (11.58 m) at a gable, in height.
	Sheet Metal	4 in. (101.6 mm)	Fastener: Minimum #10 screw(s) with 1 3/8 in. (34.9 mm) penetration into backing. Exterior veneer exceeding 30 ft (9.1 m), or 38 ft (11.58 m) at a gable, in height above the vertical support shall be designed and detailed to provide for differential movement.
	Adjustable	6 in. (152 mm)	Fastener: Minimum #10 screw(s) with 1 3/8 in. (34.9 mm) penetration into backing. Exterior veneer exceeding 30 ft (9.1 m), or 38 ft (11.58 m) at a gable, in height above the vertical support shall be designed and detailed to provide for differential movement.
Cold-formed Steel Light ~~Steel~~ Frame	Adjustable	6 in. (152 mm)	Fastener: Minimum ~~corrosion resistant~~ No. 10 screw(s) extending through the steel framing a minimum of three exposed threads. Steel framing shall be corrosion resistant and have a minimum base metal thickness of 0.043 in. (1.1 mm). Exterior veneer exceeding 30 ft (9.1 m), or 38 ft (11.58 m) at a gable, in height above the vertical support shall be designed and detailed to provide for differential movement.
Concrete	Adjustable	6 in. (152 mm)	~~Fastener:~~ Fasteners shall meet the pullout resistance requirements of Section 13.2.2.3.2. ~~Minimum 3/16 in. (4.76 mm) screw(s) with 1.5 in. (38.1 mm) embedment.~~
Clay or Concrete Masonry	Adjustable, Unit Wire, or Joint Reinforcement	6 in. (152 mm)	~~Fastener:~~ Fasteners shall meet the pullout resistance requirements of Section 13.2.2.3.2. ~~Minimum 3/16 in. (4.76 mm) screw(s) with 1.5 in. (38.1 mm) embedment.~~ [1]
[1] Unit wire ties and joint reinforcement do not require fasteners.			

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:									
12	*Affirmative*	1	*Affirmative w/ comment*	0	*Negative*	0	*Abstain*	0	*Did not vote*

Subcommittee Comments: The comment resulted in editorial changes to the table by removing the redundant use of the term fastener.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-065B1		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 65		
This ballot item proposes the following response to the Public Comment:		
☐	Committee agrees with public comment, change is proposed	
☒	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☐	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Background:
Ballot 21-VG-065B responds to Public Comment 65 and proposed a change to Table 13.2.2.3. During editorial review, it was discovered that there was also commentary that should be deleted. Since the deletion of the commentary was not a part of the subcommittee ballot, and there was not time for an additional subcommittee ballot, this ballot is being put forth by the Chair per TCOM procedures to delete the commentary.

Please see ballot 21-VG-065B for the public comment and response. For voter convenience the code change is also shown in this ballot. This ballot item is only valid if 21-VG-065B passes.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code: No changes are being proposed to the Code in this ballot. Relevant changes to Table 13.2.2.3 in ballot 21-VG-065B are shown for voter convenience.

Table 13.2.2.3 – General prescriptive anchored veneer requirements

Backing	Veneer Tie Type	Maximum Specified Cavity Width	Other requirements
Concrete	Adjustable	6 in. (152 mm)	~~Fastener:~~ Fasteners shall meet the pullout resistance requirements of Section 13.2.2.3.2. ~~Minimum 3/16 in. (4.76 mm) screw(s) with 1.5 in. (38.1 mm) embedment.~~
Clay or Concrete Masonry	Adjustable, Unit Wire, or Joint Reinforcement	6 in. (152 mm)	~~Fastener:~~ Fasteners shall meet the pullout resistance requirements of Section 13.2.2.3.2. ~~Minimum 3/16 in. (4.76 mm) screw(s) with 1.5 in. (38.1 mm) embedment.~~ [1]
[1] Unit wire ties and joint reinforcement do not require fasteners.			

Code Commentary:

13.2.2.3 *General requirements —*

~~Although Table 13.2.2.3 contains only one deemed-to-comply fastener requirement for masonry and concrete backings, other fasteners with equivalent strength can be used, but would need to be verified with an engineered design.~~

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
0 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments:

2022 TMS 402/602 Committee
Response to Public Comment

Committee: Main Committee	**Ballot #: 21**
Item #: 21-VG-073	
Technical Contact/Email: John Chrysler jc@masonry.pro	
Public Comment Number: 2022 Comment # 073	
Public Comment Response Based on TMS 402/602 Draft Dated	**6/1/2021**

This ballot item proposes the following response to the Public Comment:

- ☐ ***Committee agrees with Public Comment, change is proposed***
- ☐ ***Committee agrees comment has merit but proposed changes are not completely consistent with Public Comment***
- ☐ ***Committee disagrees with Public Comment and no changes are proposed***
- ☒ ***Committee unable to fully develop a response to Public Comment***
- ☐ ***Public Comment only requires a response, no change to document***

Public Comment:

There is potential confusion about the use sheathing and cement backing units in adhered veneers supporting by light frame backing. As I understand it, there is intended to be two options:

*Sheathing: TMS 402/602 does not define this material; presumably it can be any IBC compliant sheathing. It would be helpful to state that in the commentary. Sheathing is always used in conjunction with lath and a scratch coat. The fastening in Tables 13.3.2.5 and 13.3.2.6 is for the attachment of the lath to the backing, not of the sheathing to do the backing. If that is correct, these tables should be labeled as "Lath Fastener . . ."?, not "Veneer fastener . . ."?

Functionally, there is lack of clarity about the purpose of the sheathing. The commentary to 13.3.1.1 states "When sheathing is present behind an adhered veneer, other than providing a load path for compressive out-of-plane loads into the backing, it is assumed to provide no contribution to the strength or stiffness of the adhered veneer assembly or fasteners."? In contrast to that, the commentary to 13.3.2.5 (f) states "Adhered veneer assemblies are not intended to span between framing members and thus require the presence of sheathing to perform as intended."? Does the sheathing need to be able to span between the light frame backing members or not? If it does, the code should provide either prescriptive or performance requirements for the sheathing.

Cement Backer Units: TMS 402/602 does not define this material. The veneer may be directly adhered to this material. If the veneer is directly adhered to the cement backer units, an engineered design would be required to determine the required properties of the cement backer units and the fastening of the cement backer units to the backing. Since adhering veneers directly to cement backer units is referenced multiple times in the standard, it would be good to state explicitly whether that system requires an engineered design.

Response/Rationale:

Due to higher priority items and a significant number of Public Comments affecting masonry veneer, the Committee was not able to address this item. It will be carried forward as new business in the next cycle.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

None

Code Commentary:

None

Specification:

None

Specification Commentary:

None

Subcommittee Vote:				
0 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments:

This ballot item submitted by Chair in accordance with Technical Committee Operations Manual Section 4.2.1.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-098B		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 98		
This ballot item proposes the following response to the Public Comment:		
☐	Committee agrees with public comment, change is proposed	
☒	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☐	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

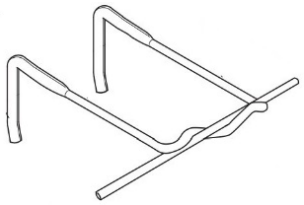
Public comment:
Ballot item 17-VG-013A proposed changes to Section 13.2.1.4. There was a negative on this ballot item which was found persuasive on ballot item 18-VG-013A. The rationale for finding the negative persuasive was that the negative provided improved language. However, there was no ballot to make the change with the improved language. Please consider the following for the code and commentary.
13.2.1.4 Joint thickness -
13.2.1.4.1 For specified veneer ties that rely on embedment in mortar for strength, the specified mortar bed joint thickness shall be at least twice the thickness of the veneer tie.
13.2.1.4.2 For veneer ties that utilize a mechanical connector or engage horizontal reinforcement for anchorage, the specified mortar joint thickness shall be greater than the thickness of the tie.

Code Commentary:
13.2.1.4 Joint thickness - There are ways in which veneer ties and joint reinforcement may co-exist in the same joint. This provision is not intended to prohibit the placement of joint reinforcement and veneer tie in the same bed joint, but they must not be stacked to exceed the maximum joint thickness if the tie derives it strength by embedment in the mortar.
Wire joint reinforcement and veneer ties installed in the same bed joint have performed well. The veneer tie and joint reinforcement may bypass each other if the veneer is sufficiently thick to allow minimum cover over both. The embedded tie may allow joint reinforcement to be depressed wire so that they can be stacked as long as the combination of tie and joint reinforcement does not exceed half the specified joint thickness. The configuration of the veneer tie may provide a mechanical attachment, but veneer tie manufacturers' installation instructions should be consulted to specify appropriate configurations. If the veneer tie utilizes the joint reinforcement for anchorage, Section 13.2.1.4.1 still applies away from the tie. *[Page 277, Line 15; Section 13.2.1.4]*

Response: More explanation is required for when a veneer tie and wire reinforcement is located in the same joint. As pointed out by the Public Comment this was attempted on other ballots. Most of the language provided in the public comment is used with alternate wording for clarity. In addition, the term "joint reinforcement" is replaced with "veneer wire reinforcement" so that the requirement applies to either single wires or parallel wire joint reinforcement.

This ballot item is predicated on Ballot item 21-VG-103B passing. If 21-VG-103B does not pass, this ballot will be withdrawn.

As a guide for the committee, here is one example of a veneer tie that has a mechanical attachment with veneer wire reinforcement.



PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code:

13.2.1.4 *Joint thickness for veneer ties* – ~~Specified mortar bed joint thickness shall be at least twice the thickness of the specified embedded veneer tie.~~
13.2.1.4.1 For specified veneer ties that rely on embedment in mortar for strength, the specified mortar bed joint thickness shall be at least twice the thickness of the veneer tie. If the joint also has veneer wire reinforcement stacked on the veneer tie, the specified mortar bed joint thickness shall be at least twice the combined thickness.
13.2.1.4.2 For veneer ties that utilize a mechanical connector to engage veneer wire reinforcement for anchorage, the specified mortar joint thickness shall be greater than the combined thickness but no less than twice the thickness of the veneer wire reinforcement.

Code Commentary:

13.2.1.4 *Joint thickness for veneer ties* –This provision is not intended to prohibit the placement of veneer wire ~~joint~~ reinforcement and veneer ~~tie~~ ties in the same bed joint.~~, but they must not be stacked to exceed the maximum joint thickness.~~ Three options exist:
(a) Veneer ties that rely on mortar embedment can be placed side by side with the veneer wire reinforcement such that the minimum joint thickness is at least twice the thickness of either.
(b) Veneer ties that rely on mortar embedment can be stacked but not connected to the veneer wire reinforcement provided the minimum joint thickness is at least twice their combined thickness.
(c) Veneer ties that rely upon mechanical anchorage with the veneer wire reinforcement can be used provided the mortar joint is thicker than the combined thickness of the veneer tie and wire and no less than twice the thickness of the veneer wire reinforcement.

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
12 *Affirmative*	1 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: The comment resulted in editorial changes to the commentary to make it easier to read.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-103B		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 103		
This ballot item proposes the following response to the Public Comment:		
☒	Committee agrees with public comment, change is proposed	
☐	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☐	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comment:
Veneer not laid in running bond is required to have "joint reinforcement" consisting of at least one wire. Joint reinforcement is defined in both TMS 402 and TMS 602 as a product conforming with ASTM A951, i.e. a welded assembly of wires. The mostly commonly used material for this application is not a welded assembly of wires; it is a single knurled wire. As a result, it is suggested that this material be defined as "Veneer joint reinforcement" or "veneer reinforcement" and be defined in TMS 602 as consisting of one of the following products:

- ASTM A1064 wire or ASTM A580 stainless steel wire, meeting the mechanical properties required for joint reinforcement, and knurled in accordance ASTM A951.
- Deformed wire reinforcement
- ASTM A951 joint reinforcement (this could be used, for example if three wire joint reinforcement was used to reinforce the masonry backing, the veneer and act as a veneer tie.

It is also suggested that rather than list a single wire size for all widths of veneer, that the area of steel be required to conform to Section 4.6. The commentary could then suggest wire size and spacing for typical veneer widths. (Note that the commentary currently references Section 4.5; this should be Section 4.6.)
Lastly, it is suggested that the placement requirements for this material in TMS 602 3.4 B.11 be reviewed for this specific application. For example, consider requiring that veneer joint reinforcing be centered on the wythe when solid units are used. *[Page 277, Line 11-14; Section 13.2.1.3]*

Response: Changes are made consistent with public comment.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code:

13.2.1.3 *Veneer not laid in running bond* – Anchored veneer not laid in running bond shall be reinforced with veneer wire reinforcement that conforms to one of the following:

(a) at least one wire of minimum size W1.7 (MW11) with deformations knurled in conformance with ASTM A951

(b) at least one deformed wire of minimum size D 2 (MD 13)

(c) joint reinforcement of minimum size W1.7 (MW11)

The reinforcement shall meet the minimum area requirements of Section 4.6 and be spaced at a maximum of 18 in. (457 mm) on center vertically.

Code Commentary:

13.1.2.2 *Deformation and differential movement*

. . . .

Masonry veneer can be designed with horizontal and vertical bands of different materials. The dissimilar physical properties of the materials should be considered when deciding how to accommodate differential movement. Industry recommendations are available regarding horizontal bands of clay masonry and concrete masonry, and address such items as ~~joint~~ reinforcement, slip planes, and sealant joints (NCMA TEK 5-2A (2002); BIA TN 18A (2019)). Vertical movement joints can be used to accommodate differential movement between vertical bands of dissimilar materials.

. . . .

13.2.1.3 *Veneer not laid in running bond* ~~–The required area of joint reinforcement is equivalent to that in Section 4.6 for a nominal 4-in. (102-mm) wythe.~~ For commonly available W1.7 (MW11) wire this would correspond to a maximum spacing of 18 in. (457 mm) for nominal 3 in. (76 mm) wythes and 16 in. (406 mm) for nominal 4 in (102 mm) wythes.

3.2.1.4 *Joint thickness for veneer ties* – This provision is not intended to prohibit the placement of ~~joint~~ wire reinforcement and veneer tie in the same bed joint, but they must not be stacked to exceed the maximum joint thickness.

Specification:

2.4 E. *Veneer wire reinforcement* — Provide veneer wire reinforcement that conforms to one of the following:

1. Wire with deformations knurled in conformance with ASTM A951. Wire shall be one of the following types:
   (a) ASTM A1064/A1064M wire meeting the minimum mechanical properties of ASTM A951.
   (b) ASTM A580/A580M, AISI Type 304 or Type 316 stainless steel and having a minimum yield strength of 45 ksi (310 MPa) and a minimum ultimate tensile strength of 90 ksi (620 MPa).
2. Deformed wire that conforms to ASTM A1064/A1064M.
3. Joint reinforcement that conforms to Article 2.4 D.

[renumber subsequent sections]

3.4 B. *Reinforcement*

. . . .

11. Joint reinforcement, veneer wire reinforcement, and deformed wire reinforcement in mortar
    a. Place ~~joint~~ reinforcement ~~and deformed wire~~ so that longitudinal wires are embedded in mortar with a minimum cover of 1/2 in. (12.7 mm) when not exposed to weather or earth; or 5/8 in. (15.9 mm) when exposed to weather or earth. Center veneer wire reinforcement on the wythe when the veneer is constructed with solid units.
    b. Provide minimum 8-in. (203-mm) lap splices for joint reinforcement and veneer wire reinforcement. Provide minimum lap splice length of 48 wire diameters for deformed wire. Do not stack ~~joint~~ reinforcement ~~wires~~ at laps.

c. Provide continuity of ~~joint~~ reinforcement ~~and deformed wire~~ at corners and intersections, unless a movement joint is detailed at the corner or intersection. Do not bend the wires more than once when field fabricating ~~joint~~ reinforcement corners except for minor adjustments to meet as-built conditions.
d. Ensure that all ends of ~~deformed wire and longitudinal wires of joint~~ reinforcement at laps are embedded in mortar or grout.

Specification Commentary:

2.4 E. *Veneer joint reinforcement* — Joint reinforcement is most commonly used as veneer wire reinforcement when masonry backing is used, and typically has three longitudinal wires - one for each face of the backing, and one for the veneer. The cross wires act as veneer ties.

3.4 B. *Reinforcement*

. . . .

11. *Joint reinforcement, veneer wire reinforcement, and deformed wire in mortar*
a. There must be a minimum protective cover for the ~~deformed wire and joint~~ reinforcement as shown in Figure SC-12. Deeply tooled mortar joints, which provide inadequate protective cover, should be avoided.
b. The requirement for lap splices provides continuity of the ~~joint~~ reinforcement ~~and deformed wire~~.
c. Continuity of reinforcement at wall intersections and corners may be provided by installing prefabricated tees and corners. Field fabricated configurations for all reinforcing types may also be acceptable provided the corrosion protection requirements are met. Prefabricated tees and corners of reinforcement protrude significantly from the wall. Bending and rebending ~~these installed components~~ protruding reinforcement during construction to avoid interference should not be permitted because wire integrity and wire flatness are adversely affected. Consequently, only minor adjustments after the initial bend are permitted. Alternatively, ~~joint~~ reinforcement placed in mortar ~~and deformed wire~~ could be limited to connecting intersecting walls that are erected at the same time.
d. Where laps ~~in deformed wire~~ occur in ~~longitudinal wires of joint~~ reinforcement the minimum embedment provisions of Article 3.4 B.10.a apply. Figure SC-13 shows typical joint reinforcement lap splices in mortar or grout.

[no change to Figures SC-12 and SC-13]

Subcommittee Vote:				
13 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: None.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee	**Ballot #:** 21
Item #: 21-VG-112-186	
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109
Draft Document Dated:	**10/26/2021**
Response to Public Comment No.: 112 and 186	
This ballot item proposes the following response to the Public Comment:	
☐	Committee agrees with public comment, change is proposed
☐	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment
☒	Committee disagrees with public comment and no changes are proposed
☐	Committee unable to fully develop a response to public comment
☐	Public comment only requires a response, no change to document

Public comments:

112 – Table 13.3.2.5 has a number of assumptions that were used in the design. The commentary indicates that many other factors can influence the nail design. As the commentary is not code, I suggest that you add footnotes to this table defining the conditions where this table is applicable, similar to what is provided for specific gravity. The very least you should indicate that these values are for fasteners placed in the dry condition, used in a dry conditions, and in the side grain of the wood. *[Page 246, Line 22-71; Table 13.3.2.5]*

186 – The tables should list all the assumptions used in developing the values and specify that conditions not satisfying those requirements must be engineered. *[Page 246-247, Line 1; Table 13.3.2.5 & 13.3.2.6]*

Response:

These assumptions are stated in the commentary to 13.3.2.5 (e). Design assumptions are not always used in the Tables in the code, e.g. Table 8.2.4.2 on allowable flexural tensile strength (no info on IRA of units) or TMS 602 Table 2 on f'm of CMU (h/t ratios used in ASTM C1314). No changes are recommended.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code: NONE

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
12 *Affirmative*	1 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: The comment was resolved in response to PC 14&15.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-129-1-167		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 129 and 167		
This ballot item proposes the following response to the Public Comment:		
☐	Committee agrees with public comment, change is proposed	
☒	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☐	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comments:

PC 129-1 *This public comment has 7 parts to it and each one is being balloted separately for ease of resolution.*

Section 13.3.2.1. TMS should provide more guidance for testing per ASTM C482 or consider developing its own ASTM standard for adhered veneer. ASTM C482 is a tile shear bond strength testing using a ceramic tile and portland cement paste as the mortar. Without heavy modification, it is not suitable for adhered veneer. There needs to be clarification of:

a. What backing (substrate) should be used? C482 has two mortar mix options in Section 9.1 (cement/sand or cement/lime/sand). However, these do not necessarily represent the substrate the adhered veneer will actually be applied to. Would it be more accurate to use a substrate that better matches the real backing (i.e., CMU, ASTM C926 plaster, etc.)?

b. C482 Section 9.2 requires the veneer to be applied to the substrate between 1 to 1.5 hours after molding. Veneer could never be installed this quickly in the field. I think the substrate should be conditioned similarly to what will occur in the field, which would vary depending on the answer to the question in 1.a above.

c. As best I can tell, the intent of Section 13.3.2.1 is to use the actual mortar and veneer unit, but this section does not clearly state this. I think it should be more clear.

[Page 45, line 17; Section 2.2]

PC 167 - Table CC-13.1.1 is incorrect. Cast stone is permitted to be used under both the prescriptive and engineered adhered veneer provisions. (See Code Section 13.3.2.1.) Natural stone is permitted only under the engineered option as an adhered veneer. *[Page 223, Line 10; Table CC-13.1.1]*

Response: Section 13.3.2.1 is clear that the units and mortar that need to meet the requirements are the materials to be tested. Currently, ASTM C482 is often modified by labs when testing adhered masonry veneer units as some of the methods are more appropriate for tile. A sentence was added to the commentary to address the issues of what is being tested in C482 for adhered veneers, but this ballot item does not get more specific since the modifications depend on unit configuration, setting bed materials and backing. There was discussion at the VG Subcommittee meeting on 2/10 of working with ASTM on either suggesting modifications to ASTM C482 or developing a companion standard for testing of adhered veneer. This will be taken up as new business during the next cycle.

In regard to PC 167, the information on cast stone was corrected with Ballot Item 19-VG-167 which received no negatives and no comments. In regard to natural stone, this material may be used with prescriptive design as long as

information is provided that a minimum bond of 50 psi is achieved as stated in Section 13.3.2.1. Additional language was added to clear up any confusion between ASTM C482 and C1823 and how they are used.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code:

13.3.2.1 *Permitted units* — Prescriptively-designed adhered veneer shall be constructed of units complying with ASTM C1088, ASTM C1364, ASTM C1670/C1670M, or ASTM C1877. Units complying with ASTM C73 or TMS 602 Article 2.3 C shall be permitted provided the bond developed between adhered veneer units and backing has a shear strength of at least 50 psi (345 kPa) based on gross unit bonded area when tested in a laboratory in accordance with ASTM C482 using the specified unit, mortar and substrate.

Code Commentary:

13.3.2.1 *Permitted units* – The design strengths are based on bond between the unit and the mortar, and the backing and the mortar. The strength of other components in the system also needs to be considered. The strength could be controlled by the backing, such as a shear failure in a cement backer unit or within other layers within the system. Field quality assurance testing of adhered masonry veneer may use ASTM C1823 to confirm compliance.

ASTM C482 is a laboratory test method to qualify that an adhered masonry unit develops adequate bond strength at its bonding surface with a specified adhesive over a specified substrate. The method is often adapted to include materials that will be used in construction. ASTM C482 is not intended to evaluate the bond strength between various combinations of masonry units, setting bed mortar, membranes, and backings. Testing procedures should be modified for the materials used and testing conditions.

~~Alternately,~~ ASTM C1823 is a test method that is used in the field to measure the shear bond strength in situ. This test method includes failure modes beyond the normal unit and mortar bond, therefore failures that occur within the units or within the substate may not be appropriate for qualifying materials (Dillon and Dalrymple (2021)).

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote: Item #129-1 and Item #167, respectively									
10	*Affirmative*	1	*Affirmative w/ comment*	2	*Negative*	0	*Abstain*	0	*Did not vote*
12	*Affirmative*	0	*Affirmative w/ comment*	1	*Negative*	0	*Abstain*	0	*Did not vote*

Subcommittee Comments: These PCs were originally two separate ballot items on Subcommittee Ballot 2022-01, but were combined during discussion of negatives on each item at the Subcommittee meeting on 2/10/2022. All Negatives were found persuasive at the VG Subcommittee Meeting – Votes: 12, 0, 0. Changes were made to the ballot item based on the negatives and comment. The changes were approved by the voting members at the meeting and appear on this ballot item – Vote: 12, 0, 0.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-129-2		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 129		
This ballot item proposes the following response to the Public Comment:		
☐	Committee agrees with public comment, change is proposed	
☐	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☒	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comment:
This public comment has 7 parts to it and each one is being balloted separately for ease of resolution.

Section 13.3.2.2. Commentary. The commentary states that "consideration should be given to back buttering the unit". Even at the old 15 psf limit, the units should have greater than 95% coverage to help ensure long-term performance. If the weight limit is going to be increased to 30 psf, using proper installation methods will be even more important. I think additional commentary or requirements for coverage and installation should be included. *[Page 242-248, Line 1-90; Section 13.3.2]*

Response:
TMS 402 Section 13.3.2.3 and TMS 602 Article 3.3 D both emphasize the importance of workmanship. Inspection requirements have also been added to address proper workmanship. No changes are proposed.

[For voter's convenience here is Section 13.3.2.3]:

13.3.2.3 *Scratch coat, setting bed, and jointing mortar requirements* — Prescriptive design requires the use of polymer modified mortar for the setting bed. When installed properly, polymer modified mortars typically have superior bond strength. However, the use of polymer modified mortars will not compensate for unsuitable or poorly prepared substrates, substrates having contaminants, improper mortar preparation or poor workmanship including partially filled setting beds. Scratch coats and pointing mortar use either traditional mortar or polymer modified mortar.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code: NONE

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
13 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: None.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee	**Ballot #:** 21
Item #: 21-VG-129-3	
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109
Draft Document Dated:	**10/26/2021**
Response to Public Comment No.: 129	
This ballot item proposes the following response to the Public Comment:	
☐	Committee agrees with public comment, change is proposed
☐	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment
☒	Committee disagrees with public comment and no changes are proposed
☐	Committee unable to fully develop a response to public comment
☐	Public comment only requires a response, no change to document

Public comment:
This public comment has 7 parts to it and each one is being balloted separately for ease of resolution.

Section 13.3.2.3.a. This section covers a mortar scratch coat using a full setting bed. Most of the Western US typically applies adhered veneer over three coat or one coat plaster systems. I think it would be good to add a full plaster system as a backing option. *[Page 242-248, Line 1-90; Section 13.3.2]*

Response:
Some veneer plaster bases are not recommended for exterior applications and therefore are not equivalent to a mortar scratch coat. Other scratch coat systems that don't conform to the prescriptive requirements of Section 13.3.2.3 can be used when using the engineered design provisions of Section 13.3.3 or with the use of a proprietary system meeting alternate design requirements.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code: NONE

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
12 *Affirmative*	0 *Affirmative w/ comment*	1 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: The Negative was withdrawn at the VG Subcommittee Meeting on 2/10/2022.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-129-4		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 129		
This ballot item proposes the following response to the Public Comment:		
☐	Committee agrees with public comment, change is proposed	
☒	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☐	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comment:
This public comment has 7 parts to it and each one is being balloted separately for ease of resolution.

Section 13.3.2.3.c. The "jointing mortar" term is only used in this section and is not defined anywhere in the TMS. It should be defined. *[Page 242-248, Line 1-90; Section 13.3.2]*

Response:
The phrase has been modified as noted.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck through~~.)*

Code:

13.3.2.3
. . .
(c) ~~Jointing mortar~~ Mortar between units shall comply with TMS 602 Article 2.1 A, Type S or N, or Article 2.1 B.

Code Commentary:

13.3.2.3 *Scratch coat, setting bed, and jointing mortar requirements* — Prescriptive design requires the use of polymer modified mortar for the setting bed. When installed properly, polymer modified mortars typically have superior bond strength. However, the use of polymer modified mortars will not compensate for unsuitable or poorly prepared substrates, substrates having contaminants, improper mortar preparation or poor workmanship including partially filled setting beds. Scratch coats and ~~pointing~~ mortar joints between units use either traditional mortar or polymer modified mortar.

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
12 *Affirmative*	1 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: The comment resulted in a change to the code to be consistent with the commentary. The change was approved by the voting members at the meeting and appear on this ballot item – Vote: 12, 0, 0.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-129-5		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 129		
This ballot item proposes the following response to the Public Comment:		
☐	Committee agrees with public comment, change is proposed	
☐	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☒	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comment:
This public comment has 7 parts to it and each one is being balloted separately for ease of resolution.

Section 13.3.2.5 (f). I do not see anything regarding sheathing in TMS 602 ~~3.3.C.1~~ [3.3.D]. Does this requirement apply to assemblies with only a scratch coat and setting bed? In other words, if a three coat or one coat plaster system was used, would sheathing still be required? This section needs clarification. *[Page 242-248, Line 1-90; Section 13.3.2]*

Response:
Yes, sheathing is still required for any of the systems mentioned as stated in Section 13.3.2.5 (f). No further clarification is necessary, therefore no changes are proposed.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code: NONE

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:									
13	*Affirmative*	0	*Affirmative w/ comment*	0	*Negative*	0	*Abstain*	0	*Did not vote*

Subcommittee Comments: None

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-129-6		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 129		
This ballot item proposes the following response to the Public Comment:		
☐	Committee agrees with public comment, change is proposed	
☒	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☐	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comment:
This public comment has 7 parts to it and each one is being balloted separately for ease of resolution.

Section 13.3.3.e Commentary: "If masonry units do not comply with Section 13.3.2.1, testing would need to be performed. The testing would primarily be to determine the shear bond strength and the modulus of rupture." Shear bond strength is tested per ASTM C482 per Section 13.3.2.1. What test is needed for modulus of rupture? Section 11.1.8.3 mentions ASTM C78 for testing modulus and C78 "Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)" seems like the proper test, but it should be stated in this section. *[Page 242-248, Line 1-90; Section 13.3.2]*

Response:
Modulus of rupture is not necessary as we provide deflection limits in Section 13.3.1.2 to limit curvature and possible debonding. However, language regarding MOR should be removed and is balloted below.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code: NONE
Code Commentary:

13.3.3 *Engineered design of adhered masonry veneer -*
….
If masonry units do not comply with Section 13.3.2.1, testing would need to be performed~~. The testing would primarily be~~ to determine the shear bond strength~~ and the modulus of rupture~~.

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
13 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: None

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-129-7		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 129		
This ballot item proposes the following response to the Public Comment:		
☐	Committee agrees with public comment, change is proposed	
☐	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☒	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comment:
This public comment has 7 parts to it and each one is being balloted separately for ease of resolution.

Section 13.3.3.f. The term "flexural tension design strength" does not appear anywhere else in the TMS 402; "flexural tension stress" appears a few times without definition. These terms should be defined. The "shear stress" is not defined either but is likely the ASTM C482 shear bond strength; this needs to be clarified.
[Page 242-248, Line 1-90; Section 13.3.]

Response:
If the engineered design method is used for adhered veneer, you will also need to also use other parts of the code. Flexural tension stress is used in Chapter 8 (Section 8.2.4.2). Design strength is defined in Section 2.2. In addition, the commentary to Section 13.3.3 explains design strength, "The design strengths are conservative values for modern dry-set mortar. The design strengths given implicitly include a strength-reduction factor and can be directly compared to strength level loads."

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code: NONE

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
13 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: None

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-144-148		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 144 and 148		
This ballot item proposes the following response to the Public Comment:		
☐	Committee agrees with public comment, change is proposed	
☐	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☒	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comment:

144 – This subsection provides values that can be assumed for flexural tension and shear design strength but there are no references provided for these values. In my personal research I have yet to find any test results reported in any peer-reviewed publications that would substantiate the shear design strengths listed. To-date there is still no industry standard to my knowledge for testing the in-situ field shear bond strength of installed AMV. ASTM C1823 for adhered dimension stone provides some basis, but even then, it was only published last year.

We recently performed shear bond testing on a newly installed AMV mockup panel. The panel was constructed under a level of QA that is above what is typically for AMV construction, including verification of substrate preparation and continuous visual observations. When tested at 35 days a third of the specimens (three out of nine) did not achieve 50 psi (see Dillon & Dalrymple, 2021, reference below). While this was an isolated test, the lower-than-expected strengths despite the better-than-average QA suggest that the 50-psi value may not be as "conservative" as the commentary claims.

I'd be slightly less concerned about the listed design values if there were some requirements for quality assurance to verify that the assumed design values are actually achieved in the field, but no QA requirements are provided for AMV less than 60 in height. I recommend that recommended design value be withheld from TMS 402 until they can be substantiated by sufficient field testing of AMV installations. Omitting the design strength values will not prohibit the design professional from using the engineered design method, but it would place responsibility on the designer to determine appropriate design strength values and to put in place requirements to verify that the assumed strengths are realized.

Ref: Dillon, P. B. and Dalrymple, G. A. (2021). "In-Field Shear Bond Strength Testing of Adhered Masonry Veneer." Proc. 14th Canadian Masonry Symposium, Montreal, QC, Canada. *[Page 248, Line 17-18; Section 13.3.3(f)]*

148 – This section provides qualitative installation criteria for the direct adhesion of AMV to concrete or masonry backings. Similar requirements are also found in § 3.3.D.2. The requirements require the backings be free of materials that would inhibit bond to the backing, but do not provide any quantitative requirements for what that bond strength needs to be.

The bond strength is not only dependent on the backing condition, it has been found to also be highly influenced by the installation practices. It has been observed that the installation requirements in Section 3.3.D.4.a do not prevent the formation of voids in the setting bed, even under watchful supervision and careful compliance with the requirements.

It should also be remembered that A118.4 and A118.15 are material standards (not installation standards) and that the bond strengths listed in those standards are for adhesion between the mortar and ceramic tile under carefully

controlled lab conditions. Those strength values would not be in any way representative of the bond strength between the mortar and concrete or masonry backing achieved in the field.
These points are somewhat compounded by the fact that there are no special inspection requirements for prescriptively design AMV installation below 60 ft. Frankly, based on the AMV failures I've seen, the thought of 75-pound AMV units installed 59 feet in the air without any inspections scares me. Either way, there is no way to verify that the assumed strengths are actually achieved in the field (or if they are even achievable in the field, given the lack of field research).
I believe there should be quantitative strength requirements for bond between AMV units and their substrate, whether it be concrete, masonry, cement board, etc. Specifying performance requirements would set a minimum standard of performance that could then be verified through testing. It also has secondary benefits.

1. For retrofit applications, it may be difficult or cost prohibitive to obtain a substrate surface that is completely free of other material but in many cases a slightly lower level of substrate preparation may still achieve the intended level of performance. By having a quantitative requirement, testing could be performed to verify whether substrate preparation requirements will meet the performance requirements.
2. It would pave the way for new, innovative systems. For example, I know of one system designed to adhere the AMV units directly to the face of the water barrier. Based on current requirements, such a system could not be designed using the prescriptive requirements. But if the prescriptive requirements were performance-based, such a system could follow the prescriptive design path if it was demonstrated to meet the performance requirements.

I also believe the special inspection requirements for AMV are too loose and recommend they be expanded to include more installations. *[Page 243, Line 14; Section 13.3.2.4 and Article 3.3 D 2]*

Response:

The 50 psi value has been in various codes and standards for decades and has served the masonry industry well. As discussed during this code cycle, many of the failures of adhered veneer have been due to faulty installation. New research in this area is welcome and will provide for better guidance in the future, but the basic requirements for shear bond strength have shown to be adequate.

The installation requirements in TMS 602 are intended to provide the correct means for providing full coverage of adhered veneer units. Designers always have the opportunity to specify more stringent inspection procedures if they want for their specific projects.

ASTM C1823, which provides procedures for field testing of adhered veneer units, recently become a standard (September 2020). As more information on appropriate test methods and procedures are revealed, specific changes to TMS 402/602 can be made at that time. This test and possible field quality assurance requirements will be discussed during the next code cycle, but are premature at this time.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown <u>underlined</u> and deletions are shown ~~struck-through~~.)*

Code: NONE

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:									
12	*Affirmative*	1	*Affirmative w/ comment*	0	*Negative*	0	*Abstain*	0	*Did not vote*

Subcommittee Comments: The comment resulted in changes to the rationale.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-145		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 145		
This ballot item proposes the following response to the Public Comment:		
☐	Committee agrees with public comment, change is proposed	
☒	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☐	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comment:
There is a disagreement between the last phrase of the sentence and the subject. The last phase is intended to refer to "adhered masonry veneer", but the actual subject of the sentence is "the prescriptive design". In other words, the sentence actually says:

> "The prescriptive design of adhered masonry veneer shall comply with the requirements of either Table 13.3.2.5 or Table 13.3.2.6 or [the prescriptive design of adhered masonry veneer] shall be directly applied to concrete or masonry backing."

I recommend rewording to align what is meant and what is said. I also recommend omitting the "prescriptive design of" piece; it is redundant since this section is nested under 13.3.2.5. I also found the connection between the first phrase and the tables to be less clear. When I initially went to the tables, I had to go back to the section and verify that I hadn't accidently gone to the wrong tables in the anchored veneer section. I think the connection between the two is described pretty clearly in the commentary, but I think having a better connection in the code itself would improve the readability of the code. Here is some suggested wording to help improve the section:
"Adhered masonry veneer units shall be applied to scratch coat and lath fastened to backing in accordance with either Table 13.3.2.5 or Table 13.3.2.6 or shall be directly applied to concrete or masonry backing." *[Page 244, Line 24; Section 13.3.2.5(e)]*

Response: The public comment has merit and changes are proposed that are consistent, but not exact, with the comment.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code:
13.3.2.5 *General Requirements –*
. . .
(e) ~~The prescriptive design of adhered masonry veneer shall comply with the requirements of either Table 13.3.2.5 or Table 13.3.2.6 or shall be directly applied to concrete or masonry backing.~~ Adhered masonry veneer shall comply with the requirements of Table 13.3.2.5, Table 13.3.2.6, or shall be directly applied to concrete or masonry backing.

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
12 *Affirmative*	0 *Affirmative w/ comment*	1 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: The Negative was found persuasive at the VG Subcommittee Meeting on 2/10/2022 – Vote: 12, 0, 0. Changes were made to the ballot item based on the negative. The changes were approved by the voting members at the meeting and appear on this ballot item – Vote: 12, 0, 0.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee	**Ballot #:** 21
Item #: 21-VG-146	
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109
Draft Document Dated:	**10/26/2021**
Response to Public Comment No.: 146	
This ballot item proposes the following response to the Public Comment:	
☐	Committee agrees with public comment, change is proposed
☐	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment
☐	Committee disagrees with public comment and no changes are proposed
☒	Committee unable to fully develop a response to public comment
☐	Public comment only requires a response, no change to document

Public comment:
13.3.2.4 requires scratch coat and lath over concrete or masonry where inadequate bond can be developed. With how 13.3.2.5(e) is worded, it would not permit prescriptive design of AMV units over scratch coat and lath fastened to concrete or masonry because Tables 13.3.2.5 and 13.3.2.6 only cover wood and steel stud backings. I suggest adding prescriptive fastener spacing for lath and plaster installations over concrete and masonry backings. *[Page 244, Line 26; Section 13.3.2.5 (e)]*

Response:
Since lath and scratch coat are rarely applied to a concrete or masonry backing, there is little information on appropriate fastener spacing for this condition. Therefore, more information is needed and appropriate requirements should be developed during the next code cycle.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code: NONE

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
13 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: None

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-153-218		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 153 and 218		
This ballot item proposes the following response to the Public Comment:		
☐	Committee agrees with public comment, change is proposed	
☒	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☐	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comment:

153 – In TMS 402, Table CC-13.1.1, prescriptive methods for dimension stone anchored veneer are prohibited. This seems reasonable for larger scale projects, large dimension stone panels, or curtainwall applications extending well above grade. But there is no reference to height or scope of the installation, so strict enforcement of this code would require a base course on a storefront to have an engineer's stamp. This seems overly restrictive, particularly when Clay, Concrete, and Cast products are allowed to be installed without an engineer's review. *[Page 223, Line 1; Table CC-13.1.1]*

218 – Your disallowing Dimension Stone from being prescriptive under Anchored Veneer. I understand the need for larger dimensional stones to be engineered but smaller split-face elements which are currently being mortar set (1'x2'x4" thick limestone elements as case in point) with bed ties are considered prescriptive designs per IBC Chapter 14 and are currently being done w/o engineering calcs or drawings. *[Page 223, Line 1; Table CC-13.1.1]*

Response:

It is appropriate to include more information on dimension stone into the prescriptive requirements of the veneer chapter due to historical performance. The following additions have been made to the code to allow dimension stone to use prescriptive design provisions of TMS 402/602. Limitations have been added to keep the size of dimension stone small so that it behaves similar to clay and concrete masonry units.

As a reminder, the veneer chapter **does not** cover stone that is set in a sealant or is independently supported by stone anchors. Dimension stone used here is similar to cast stone which also uses the prescriptive design requirements.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

This proposal is presented as new code/specification language in one column, corresponding commentary in the center column, and additional background discussion for the benefit of the Committee (blue shaded right-hand column) as was done with the initial Veneer Chapter proposal. The 'Rationale and Comments' (blue shaded column) WILL NOT be included in the TMS 402/602 and meant for you, the voter, to understand the proposed changes. This information is provided for the benefit of the Committee in their review of these new provisions.

<table>
<tr><th>TMS 402 CODE</th><th>COMMENTARY</th><th>RATIONALE AND COMMENTS</th></tr>
<tr><td>Table 4.2.3 Coefficients of Thermal Expansion
<table>
<tr><th>Material</th><th>Coefficient (k_t)</th></tr>
<tr><td>Clay Masonry</td><td>4 x 10-6 in./in./°F (7.2 x 10-6 mm/mm/°C)</td></tr>
<tr><td>Concrete Masonry and Cast Stone</td><td>4.5 x 10-6 in./ in./°F (8.1 x 10-6 mm/mm/°C)</td></tr>
<tr><td>AAC Masonry</td><td>4.5 x 10-6 in./ in./°F (8.1 x 10-6 mm/mm/°C)</td></tr>
<tr><td><u>Dimension Stone Masonry</u></td><td><u>Varies [1]</u></td></tr>
</table>
<u>[1] Specific properties for stone masonry shall be provided by the manufacturer.</u></td><td>4.2.3 Coefficients of thermal expansion
Temperature changes cause material expansion and contraction. This material movement is theoretically reversible. These thermal expansion coefficients are slightly higher than mean values for the assemblage (Copeland (1957); Plummer (1962); Grimm (1986)).

Thermal expansion for concrete masonry varies with aggregate type (Copeland (1957); Kalouseb (1954)). Thermal expansion coefficients are given for AAC masonry in RILEM (1993).

<u>Thermal expansion coefficients for stone masonry will vary depending on the type of stone. Most stone will fall in the range of 4.0 to 5.0 x 10^{-6} in/in/°F (7.2 to 9 mm/mm/°C)</u></td><td>Coefficients of thermal expansion for stone masonry are necessary to determine expansion of stone masonry when designing movement joints. Although there are no specific values given, it directs the designer to the source with the commentary giving a range of values.</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>13.2.2 Prescriptive design of anchored masonry veneer
13.2.2.1 Permitted units — Prescriptively-designed anchored veneer shall be constructed of units complying with:
(a) TMS 602 Article 2.3 A
(b) TMS 602 Article 2.3 B except ASTM C34, ASTM C56 and ASTM C1088
<u>(c) TMS 602 Article 2.3 C</u>
<u>(d)</u> <s>(c)</s> TMS 602 Article 2.3 F</td><td>13.2.2 Prescriptive design of anchored masonry veneer
13.2.2.1 Permitted units — The prescriptive requirements of anchored masonry veneers apply to conventional concrete masonry, clay masonry, <u>dimension stone</u> and cast stone masonry units laid in mortar that also meet the other limitations of Section 13.2.2. Alternative anchored veneer systems would need to be evaluated and designed in accordance with Section 13.2.3.</td><td>Stone masonry will now be permitted to use the prescriptive design method since performance of stone bedded in mortar has been shown by years of successful performance. The limitations in 13.2.2.2 will provide a boundary for the use of stone using these provisions. Design guidance from stone suppliers and industry groups have pointed to the prescriptive spacing of veneer ties for decades. Stone that does not meet the requirements of Section 13.2.2 such as stone slabs would not be able to use these provisions.</td></tr>
</table>

TMS 402 CODE	COMMENTARY	RATIONALE AND COMMENTS
13.2.2.2 *Specified weight, height, and thickness* — Prescriptively-designed anchored veneer units shall have a: (a) specified weight of 50 psf (2.4 kPa) or less, (b) specified height of 16 in. (406 mm) or less, and (c) ~~a~~ specified thickness of 5 in. (127 mm) or less	**13.2.2.2** *Specified weight, height, and thickness* The limitation on installed weight is to limit the force under seismic load, when seismic loading is a concern. Units that have an average thickness greater than 5 in. (127 mm) require an engineered analysis.	The height limits specified here **would apply to all masonry units including stone**. While there has never been a height limit for masonry units it has been debated before. Since the maximum spacing of veneer ties is 16" this value was chosen. Deflection of the veneer may be impacted by the height of the unit, but at the height limit specified, wouldn't have a large impact. A source of information on the development of code requirements for stone can be found in, "The Evolution of Stone Masonry Veneer Requirements: Past, Present, and Future" by Civitillo and Petersen (ASTM STP 1612). This is not proposed to be listed in the commentary, but could be used in committee discussions.
13.2.2.3 *General requirements* — Prescriptively-designed anchored veneer shall comply with the requirements of Table 13.2.2.3. Prescriptively-designed dimension stone anchored masonry veneer shall not exceed 30 ft (9.1 m) in height above grade plane.	**13.2.2.3** General requirements … [add to end of section] Due to empirical results and industry recommendations, dimension stone veneer height limitations should not exceed the limits stated. Dimension stone masonry walls that would exceed these limits must use the Engineered Methods in Section 13.2.3 or Section 1.3 Alternative design or method of construction.	Stone industry recommendations have stated that stone veneer should be limited in height to 30'. This is maintained in the code and provides some factor of safety for lack of information on bonding of units for different types of stone.
13.2.3 *Engineered design of anchored masonry veneer* — The engineered design of anchored veneer shall comply with the requirements of Section 13.2.3.1 and either Section 13.2.3.2 or Section 13.2.3.3. The veneer is not subject to the allowable flexural tensile stress provisions of Section 8.2.4.2 or the modulus of rupture provisions of Section 9.1.9.2. Units shall comply with Section 13.2.2.1 ~~or TMS Article 2.3 C~~, or alternately, testing shall be performed to determine necessary material properties.		Since stone is being added to Section 13.2.2.1, there is no need to reference stone from TMS 602.

Subcommittee Vote:				
8 *Affirmative*	4 *Affirmative w/ comment*	0 *Negative*	1 *Abstain*	0 *Did not vote*

Subcommittee Comments: The comments resulted in minor changes to Section 13.2.2.3 to denote that the new sentence applies to prescriptively-designed anchored veneer. Editorial changes were also made to Section 13.2.2.2 to place commas where necessary. Those in attendance at the VG Subcommittee meeting on 2/10 agreed to the changes.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-154-213		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 154 and 213		
This ballot item proposes the following response to the Public Comment:		
☐	Committee agrees with public comment, change is proposed	
☐	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☒	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comment:

154 – In TMS 402 Section 13.3.2.2, the unit weight and thickness limits for adhered veneer, as well as the height above grade plane listed in 13.3.2.5 (b) seem to be excessive and beyond my personal comfort level for most installations. Is there a document that would explain the rationale behind these limits? *[Page 243-244, Line 10; Section 13.3.2.2]*

213 – I wish to know the rational or data behind the increase of the adhered masonry from 15psf to 30psf. This is doubling the allowable and is very concerning for me as a designer. I am uncomfortable putting a 2 5/8" thick piece of concrete masonry adhered only to the wall in regions as tall as 60 ft high. This in combination with the 2" rigid insulation additions in table 13.3.2.5 do not make sense. Has any in plane load testing been performed with these assemblies to see how the system will react? Especially what will be the in-plane deflections of the assembly with a 30 psf stone, mortar bed, scratch coat assembly (which could total up to 50 psf) as the nailed assembly cantilevers thru the insulation board. How were these nail sizes and spacing determined? Empirically or by testing? I would have to see this data before I could begin to support any kind of increase of this magnitude. *[Page 243-246, Line 10-40; Section 13.3.2.2]*

Response:

In response to PC 154, the paper "Proposed Changes to the TMS 402/602 Adhered Veneer Provisions" by Thompson et al presented at the 13th North American Masonry Conference provides more background on the height limits. This paper is listed in the References for Chapter 13. As the paper states, height limitations for adhered veneer have varied in industry publications and regional building codes and in some cases doesn't exist. Adhered veneers have been used on buildings over 60' in height with examples of buildings in New York City with thin clay brick at 19 stories (thin brick on metal panel). Further examples of height limits include New York City's Façade Inspection & Safety Program which does not require buildings less than 6 stories to be inspected.

In response to PC 213, the same paper can be referenced for why the increase from 15 psf to 30 psf has been made. The limits on deflection, mortar setting bed coverage, requirements for polymer modified mortar have allowed this increase to be made. Analysis of cantilevered assemblies has been made and is the basis for Table 13.3.2.5 and 13.3.2.6.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code: NONE

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
13 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: None

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-156-157		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 156 and 157		
This ballot item proposes the following response to the Public Comment:		
☐	Committee agrees with public comment, change is proposed	
☒	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☐	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comments:

156 - This limitation is placed as a subsection of 13.1.2 and therefore applies to all methods of designing veneer - prescriptive, tributary area and engineered. It makes a lot of sense for veneer designs using prescriptive and, also, the tributary area design methods since there is not an engineering analysis being done on the veneer or its anchorage. It does not make sense, to me, though, to include the limitation for engineered design of veneer. The design engineer should be able to use the method and analytical tools to evaluate the applied load and its connection with regard to how it influences the veneer and to design to appropriate un-cracked limits using Chapters 8 or 9, in the least. Because of the wording and its placement, I don't believe that a design utilizing Chapter 8 or 9 would be permitted under the veneer chapter and it seems that the entire veneer design would have to move to one of the other design methods for masonry. This seems unnecessary and can be easily corrected by modifying the language to include 'using Section 13.2.2' between '...on the face of veneer' and shall not exceed...' This would allow any load to be included when using Section 13.2.3 (engineered).

A reasonable qualifier would be, since, or when, the veneer is treated as un-cracked and therefore un-reinforced, that a restriction be added either within the veneer chapter or added to the seismic provisions in Chapter 7. This would protect against brittle failure during seismic events.

157 - Section 13.1.2.4, and its placement would allow for the load to be applied to all adhered veneer designed using TMS 402. I have serious concerns about allowing this at this time. It seems unsafe and the section should contain a prohibition against use in Section 13.3. Consideration could be given to allowing it in 13.3.3 and not 13.3.2, for consistency with anchored veneer, but I'm not sure that there is enough data in 13.3 or completed testing that would allow a designer to well design a connection to adhered veneer... even for these modest loads.

For voter convenience, Section 13.1.2 is shown below.

> **13.1.2.4** *Limitation of applied vertical loads other than self-weight* — Superimposed allowable stress level vertical loads on the face of the veneer shall not exceed 20 pounds (89 N) vertical load applied in any 5 ft (1.52 m) by 5 ft (1.52 m) wall face area. Items attached to the veneer shall not project more than 12 in. (305 mm) from the face of the veneer.

Response: The purpose of the restriction on vertical loads is to both allow small incidental loads on the veneer, but also recognize that veneer is non-structural and with significant loads the wall system is not a veneer wall but a non-composite multi-wythe wall (Section 5.1.4.3). The committee disagrees that any load should be allowed to be applied to engineered veneer design. The committee does agree that additional guidance should be provided to the designer, which includes consideration of stability, seismic effects, permanent loads on veneer/wall ties, and other things. The committee also agrees that the 12 inch projection limit can be overly restrictive. In particular small flags are often attached to veneer which extend beyond 12 inches.
This ballot item proposes to add a moment restriction, which is the basis for the load limit (the flexural tension strength should not be exceeded), which gives greater flexibility. The committee will consider the broader issue as new business next cycle.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.) Do not use 'Track Changes'*

Code:

13.1.2.4 *Limitation of applied vertical loads other than self-weight* — Superimposed allowable stress level vertical loads on the face of the veneer shall not exceed ~~20 pounds (89 N) vertical load applied~~ the following in any 5 ft (1.52 m) by 5 ft (1.52 m) wall face area.

(a) 20 pounds (89 N) vertical load, and

(b) 180 in.-lb (20,340 N-mm) moment. Items attached to the veneer that do not project more than 12 in. (305 mm) from the face of the veneer shall be deemed to comply with this moment limitation.

~~Items attached to the veneer shall not project more than 12 in. (305 mm) from the face of the veneer.~~

Exception: This load limit may be exceeded for anchored veneers designed in accordance with Section 13.2.3.3 provided that the masonry is designed in accordance with Parts 2 and 3 of this Code.

Code Commentary:

13.1.2.4 *Limitation of applied vertical loads other than self-weight* — Because veneer is non-structural, it is not designed to carry superimposed loads. This provision allows attaching small items, such as address plates and porch lights, to the veneer. Attachments that project more than 12 in. (305 mm) from the face of the veneer ~~can~~ may have significant snow and wind loads and the designer should consider that possibility. If the applied load ~~or attachment projection~~ exceeds these limits, the masonry ~~veneer and veneer ties~~ would need to be designed using ~~either Chapter 8 or Chapter 9~~ Parts 2 and 3 of this Code ~~and form the basis of an Engineered Design~~. In particular, the masonry would have to be designed using the unreinforced masonry provisions (Section 8.2 or Section 9.2) which require the masonry to be designed to remain uncracked, or as reinforced masonry (Section 8.3 or Section 9.3). The other provisions of Chapter 13, such as the stability provisions, would still apply. The additional tie forces from the applied loads also need to be considered. ~~In an Engineered Design, masonry wythe stability should be considered if these limits are exceeded.~~

These requirements apply only to items attached to the veneer, not items that pass through the veneer and are supported by the backing.

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:									
13	*Affirmative*	0	*Affirmative w/ comment*	0	*Negative*	0	*Abstain*	0	*Did not vote*

Subcommittee Comments: None

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee	**Ballot #:** 21
Item #: 21-VG-173	
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109
Draft Document Dated:	**10/26/2021**
Response to Public Comment No.: 173	
This ballot item proposes the following response to the Public Comment:	
☐	Committee agrees with public comment, change is proposed
☐	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment
☒	Committee disagrees with public comment and no changes are proposed
☐	Committee unable to fully develop a response to public comment
☐	Public comment only requires a response, no change to document

Public comment:
The restriction of Type S mortar for setting bed mortar should be reconsidered, especially as it relates to interior applications or residential applications such as wainscots. *[Page 243, Line 22-23; Section 13.3.2.3]*

Response:
A Type S mortar setting bed can still be used, it would just require an engineer to sign off on those materials. There could be some residential applications which are quite tall and would require polymer modified mortars are required by this code. No changes are recommended.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code: NONE

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
12 *Affirmative*	1 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: The comment related to considering this topic for the next cycle was considered, but no changes were made.

2022 TMS 402/602 Committee
Proposed Negative Resolution to Masonry Standard

Committee: Main Committee	**Ballot #:** 21
Item #: **21-VG-174A**	
Technical Contact/Email: Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Resolving Negative on Ballot Item: 20-VG-174	
Negative Voter(s): Dr. Richard Bennett	
This ballot item proposes to find negative(s): ☒ ***Persuasive, Substantive*** ☐ ***Persuasive, Editorial*** ☐ ***Non-persuasive*** ☐ ***Unrelated***	

Negative:

This needs to be coordinated with ballot item 20-VG-056-067. That item, dealing with the definition of backing, modifies the commentary as follows:

> Lath and scratch coat are not required when adhered masonry veneer units are applied directly to ~~certain backings (~~concrete, concrete masonry, or cement backer units~~)~~ due to adequate bond.

This ballot item changes the sentence to:

> Lath and scratch coat are not required when adhered masonry veneer units are applied directly to certain backings ~~(concrete, concrete masonry, or cement backer units) due to~~ <u>that provide</u> adequate bond.

My negative will be withdrawn once we figure out how to reconcile the two ballots should both pass. Note also that backing is used in the following added sentence to the commentary, and that may need to be modified based on ballot 20-VG-056-067.

Differential movement between adhered veneer units and the backing should be considered as their incompatibility may result in cracks or debonding.

Rationale:

The negative voter is correct that there is a conflict, therefore, this ballot item proposes to find the Negative vote Persuasive. A separate ballot item provides language that doesn't conflict. See Ballot Item 21-VG-174B.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21-VG-174B
Item #: 174B		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 174		
This ballot item proposes the following response to the TAC comment:		
☐	Committee agrees with public comment, change is proposed	
☒	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☐	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comment:
Clay masonry walls should be included in Section 13.3.2.4 as an appropriate backing for adhered veneer without the need for lath and scratch coat. However, the section must include language that not all clay masonry backings are appropriate, for example an existing brick veneer wall or a brick that has a glazed or smooth face or an existing wall that is weathered and spalled. *[Page 243, Line 27-30]*

Response: This issue was partially addressed during TAC comments, but did not get fully resolved. The proposal is based on previous ballot items and any negatives or comments associated with those items.

This ballot item assumes that the Negative on Main 20-VG-174 will be found persuasive (Ballot 21-VG-174A).

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code:

13.3.2.4 *Installation requirements* – Lath and scratch coat shall not be required when adhered masonry veneer units are applied directly to concrete, ~~concrete~~ unglazed clay or concrete masonry, or cement backer units free of coatings, debris, membranes, or similar materials that would inhibit bond to the backing.

Code Commentary:

13.3.2.4 *Installation requirements* – Installation of adhered masonry veneer units must comply with TMS 602. Lath and scratch coat are not required when adhered masonry veneer units are applied directly to concrete, concrete masonry, or cement backer units ~~due to~~ which provide adequate bond. Differential movement between adhered veneer units and the backing should be considered as their incompatibility may result in cracks or debonding.
When concrete, clay masonry or concrete masonry walls are smooth, have a glazed coating, or where good bond cannot be achieved, adhered veneer systems should be installed over lath. The surfaces intended to receive

adhered units must have a rough texture to ensure good mortar bond. ICRI Technical Guideline 310.2 (ICRI 2013) provides information on ~~concrete~~ surface preparation, including information on Concrete Surface Profile, a standardized method to measure concrete surface roughness. A Concrete Surface Profile equal to or greater than 2 is usually acceptable for the installation of adhered veneer over concrete and masonry assemblies but verification for specific project conditions may be required. When testing is warranted due to surface texture of the substrate or the presence of a membrane or coating that may inhibit bond, the procedures of Section 13.3.3 should be followed.

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
12 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: This ballot item is a result of a Negative received on Main 20-VG-174. This ballot item was approved at the VG Subcommittee meeting on 2/10/2022 by the vote shown above.

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee	**Ballot #:** 21
Item #: 21-VG-176	
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109
Draft Document Dated:	**10/26/2021**
Response to Public Comment No.: 176	
This ballot item proposes the following response to the Public Comment:	
☐	Committee agrees with public comment, change is proposed
☐	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment
☒	Committee disagrees with public comment and no changes are proposed
☐	Committee unable to fully develop a response to public comment
☐	Public comment only requires a response, no change to document

Public comment:
Consideration should be given to non-vertical applications that are small in nature such as an L-shaped masonry unit that forms the soffit of an opening. It could be interpreted that the L-shaped unit is not allowed since it has a horizontal surface. This often applies to an arch where more decorative units are used, but may be unnecessarily restricted. *[Page 244, Line 13-14; Section13.3.2.5 (c)]*

Response: It is unlikely that a small L-shaped unit will be disallowed since the majority of the unit will be in a vertical orientation. If the majority of the unit is along the horizontal direction then it should be engineered design or proprietary applications. No change is recommended.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code: NONE

Code Commentary: NONE

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
13 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: None

2022 TMS 402/602 Committee
Proposed Change to Masonry Standard

Committee: Main Committee		**Ballot #:** 21
Item #: 21-VG-220B		
Technical Contact/Email:	Brian E. Trimble, PE, btrimble@imiweb.org, (703) 300-0109	
Draft Document Dated:	**10/26/2021**	
Response to Public Comment No.: 220		
This ballot item proposes the following response to the TAC comment:		
☐	Committee agrees with public comment, change is proposed	
☒	Committee agrees comment has merit, but proposed changes are not completely consistent with public comment	
☐	Committee disagrees with public comment and no changes are proposed	
☐	Committee unable to fully develop a response to public comment	
☐	Public comment only requires a response, no change to document	

Public comments:
…not many requirements for water management for adhered veneer compared to anchored veneers…not rational. Prevent water from entering the building…what does this mean exactly? Statements in the masonry code should be consistent with the building code requirements for permissible penetration. [*Page 242, line 33]*

For voter's convenience here is a paragraph from the IBC referenced in the Public Comment regarding weather protection that is required for all exterior walls:

> **1402.2 Weather protection.** *Exterior walls* shall provide the building with a weather-resistant *exterior wall envelope*. The *exterior wall envelope* shall include flashing, as described in Section 1404.4. The *exterior wall envelope* shall be designed and constructed in such a manner as to prevent the accumulation of water within the wall assembly by providing a *water-resistive barrier* behind the exterior *veneer*, as described in Section 1403.2, and a means for draining water that enters the assembly to the exterior. Protection against condensation in the *exterior wall* assembly shall be provided in accordance with Section 1404.3.

Response: Adhered veneers require more analysis since they can be designed as a barrier wall or a drainage wall. Adhered veneer could also be considered as "newer" wall systems as compared to anchored veneer walls and thus don't have as many prescriptive requirements. This committee will consider more prescriptive requirements for adhered veneer as more research is conducted and experience is gained on this wall system but the requirements, especially in regard to water penetration, are deemed as minimum levels appropriate for a building code at this time. In addition, a designer has the prerogative to determine what level of design and detailing is required for a particular building, especially for different climates. Therefore, having a general statement on water penetration is appropriate as is shown with Section 13.3.1.3. Slight modifications are made to align more with the IBC language.

PROPOSED CHANGES: *(Only the suggested change(s) being balloted are proposed for consideration. Supplementary text included for clarity, but not proposed for modification, is not part of this ballot item. Additions are shown underlined and deletions are shown ~~struck-through~~.)*

Code:

13.3.1.3 *Water penetration resistance* — Exterior adhered veneer wall systems shall be designed and detailed to resist water penetration ~~into the building interior~~.

Code Commentary:

13.3.1.3 *Water penetration resistance* — Water penetration through the exterior veneer is expected~~. The~~; however, the wall system must be designed and constructed to prevent water from breaching the building envelope ~~entering the building~~. Information and references on designing and detailing for water penetration resistance are located in Section 13.1.2.1.

Specification: NONE

Specification Commentary: NONE

Subcommittee Vote:				
14 *Affirmative*	0 *Affirmative w/ comment*	0 *Negative*	0 *Abstain*	0 *Did not vote*

Subcommittee Comments: None