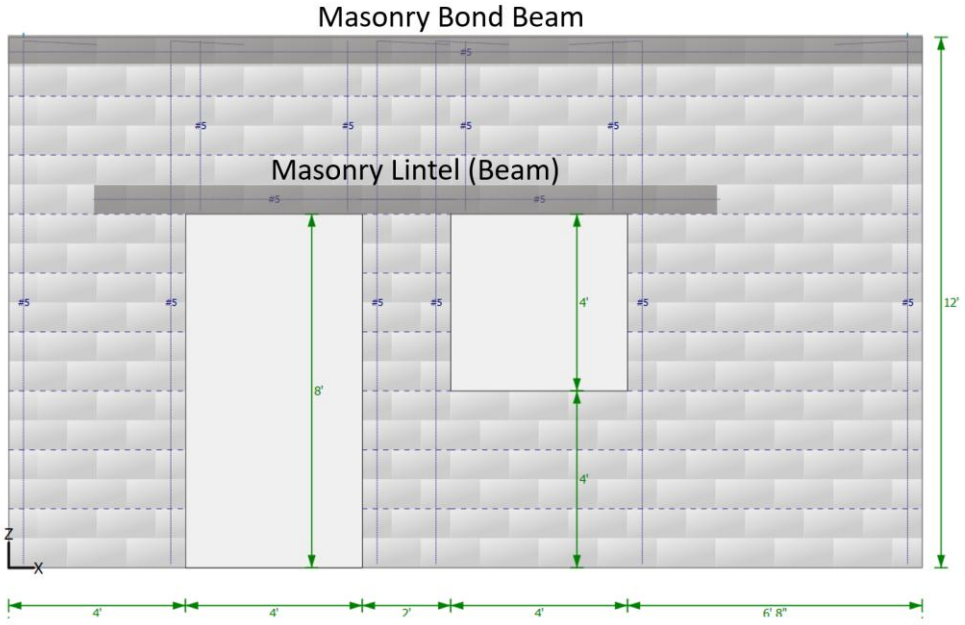
DESIGNER CHECKLIST FOR INTERMEDIATE REINFORCED CONCRETE MASONRY SHEAR WALLS BASED ON TMS 402/602-22

The lateral force-resisting system of most masonry structures is typically provided by masonry shear walls. This Checklist specifically covers the general and prescriptive design and detailing requirements for intermediate reinforced masonry shear walls. Intermediate reinforced concrete masonry shear walls are permitted to be used as part of the lateral force-resisting system in structures assigned to Seismic Design Category (SDC) A, B, and C as well as for all wind speed zones. Intermediate reinforced masonry shear walls are reinforced in the vertical direction with conventional mild reinforcement and in the horizontal direction using reinforced bond beams or joint reinforcement. Bond beams are horizontal, sloped, or stepped structural elements within masonry walls used to distribute lateral and gravity loads, provide continuity, and resist bending, shear, and torsional forces. They are particularly critical at floor and roof levels and at the tops of walls. Bond beams may also coincide with the top of openings, in which case they may also provide the dual function of a lintel. See separate Checklist DC-2-22, *Designer Checklist for Concrete Masonry Lintels*, for information specific to masonry lintels (beams) over openings. Additional Checklists related to the design and detailing of concrete masonry shear walls systems include:

- DC-4-22, *Designer Checklist for Detailed Plain Concrete Masonry Shear Walls*
- DC-5-22, *Designer Checklist for Ordinary Reinforced Concrete Masonry Shear Walls*
- DC-7-22, *Designer Checklist for Special Reinforced Concrete Masonry Shear Walls*

TMS 402 contains design modeling options for both allowable stress design (ASD) and strength design (SD). Where design checks differ between these two modeling approaches, they are addressed separately in this Checklist.



CHECK	REQUIREMENT	REFERENCE	DESIGNER NOTES
SECTION 1: MATERIAL REQUIREMENTS			
1	Concrete Masonry Units: CMU must comply with the requirements of ASTM C90.	TMS 602 Art. 2.3 A	At horizontally reinforced bond beams, use bond beam units configured to accept horizontal reinforcement and grout. Where vertical reinforcement coincides with bond beams or vertical grout continuity is required, use open-bottom units. Portions of the masonry assembly that do not contain horizontally reinforced bond beams may be constructed using hollow units of any configuration (stretcher, corner, knock-out, etc.)
2	Mortar: Complying with ASTM C270 or ASTM C1714/C1714M.	TMS 602 Art. 2.1 A	Type S mortar is recommended for loadbearing masonry elements and masonry that is part of the lateral force-resisting system. There is functionally no difference between mortar complying with ASTM C270 versus mortar complying with ASTM C1714/C1714M as each must meet the same constituent material requirements and proportion/property requirements. Mortars complying with ASTM C1714/C1714M are preblended and delivered to jobsites in bags where water is added. ASTM C270 mortars may be batched onsite from constituent materials.
3	Specify minimum compressive strength for the masonry assembly.	TMS 602 Art. 1.4 B.2, Table 2	The most common method of specifying the minimum compressive strength of masonry construction (f'_m) is by using the unit strength table of TMS 602, which establishes the masonry assembly compressive strength based on the compressive strength of the CMU and the type of mortar used in construction. Note that when high compressive strength masonry (f'_m > 3,000 lb/in.^{2}) is warranted, the use of prisms to verify the compressive strength may provide more design economy as the unit strength table becomes more conservative at high strength ranges. A calculator for determining the assembly compressive strength based on the CMU and mortar properties is available here: https://beautyofblock.com/2025/09/24/masonry-comprehensive-strength-calculator/
4	Grout: Must conform to ASTM C476.	TMS 602 Art. 2.2	ASTM C476 has options for coarse grout, fine grout, and self-consolidating grout. Coarse grout is most commonly used in concrete masonry construction unless the spaces to be grouted are congested. The primary difference between coarse grout and fine grout is the size of the aggregate in the mix, with the smaller aggregate size required of fine grout necessary to facilitate the placement and consolidation of the grout in tight spaces. As such, a fine grout can be substituted for coarse grout with no detrimental impact to the construction or performance of the masonry. However, if a fine grout is specified because of reinforcement congestion or small clearances, a fine grout complying with ASTM C476 should be used as a coarse grout may result in consolidation issues and voids within the final construction.
5	Mild Reinforcement: Must meet ASTM	TMS 602 Art. 2.4 A	ASTM A615/A615M (carbon steel) Grade 60 is most commonly used in concrete masonry construction. ASTM A706/A706M (low alloy steel) is typically used when

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	A615/A615M or ASTM A706/A706M.		reinforcement is to be welded. Other specialty reinforcement (e.g., epoxy coated) is permitted by TMS 602 where warranted.
6	Verify reinforcing steel actual yield strength (SD).	TMS 402 Sec. 9.1.9.2.1	Masonry shear walls designed in accordance with the strength design provisions of TMS 402 and subjected to in-plane flexural tension, the actual yield strength of the reinforcement is limited to 1.3 times the specified yield strength of the reinforcement.
7	Joint Reinforcement: Conforms to ASTM A951.	TMS 402 Sec. 6.1.5.2 TMS 602 Art. 2.4 D	Horizontal joint reinforcement is used both for crack control as well as to resist out-of-plane flexural loading. When used to resist in-plane loads, TMS 402 places additional limitations on the size and spacing of joint reinforcement as covered in this Checklist. Joint reinforcement embedded in masonry construction exposed to earth, weather, or a mean relative humidity exceeding 75% are required to be hot-dip galvanized. Mill galvanizing of the joint reinforcement is permitted for all other applications.
SECTION 2: STRUCTURAL DESIGN CHECKS			
8	Select design methodology.	TMS 402 Sec. 7.3.2.3	Intermediate reinforced masonry shear walls are required to be designed as reinforced masonry using either the allowable stress (Chapter 8) or strength design (Chapter 9) methods.
9	Select bond pattern.	TMS 402 Sec. 4.7	Running bond and stack bond are the two most frequently used bond patterns used for the construction of concrete masonry walls. When using stack bond construction, TMS 402 requires a minimum area of horizontal reinforcement to maintain continuity across the mortared head joints. This reinforcement may also be used for crack control or resisting out-of-plane loads.
10	Check in-plane shear strength (ASD).	TMS 402 Sec. 8.3.5	Required when bond beams are used to resist in-plane loads.
11	Check in-plane shear strength (SD).	TMS 402 Sec. 9.3.3.1.2	Required when bond beams are used to resist in-plane loads.
12	Verify minimum spacing of shear reinforcement.	TMS 402 Sec. 8.3.5.2.1	This design check only applies if the bond beam reinforcement is used to resist in-plane shear loads. The minimum spacing of bond beam reinforcement is the lesser of $d_v/2$ or 48 in. Here, d_v is the length of the shear wall or shear wall segment.
13	Verify minimum spacing of shear reinforcement.	TMS 402 Sec. 9.3.3.2.3	This design check only applies if the bond beam reinforcement is used to resist in-plane shear loads. The minimum spacing of bond beam reinforcement is the lesser of $d_v/2$ or 48 in. Here, d_v is the length of the shear wall or shear wall segment.
SECTION 3: DETAILING AND CONTINUITY			
14	Verify reinforcement size limits, placement tolerances, and corrosion protection.	TMS 402 Sec 6.1.3-6.1.5	Verify reinforcement size limits (6.1.3.2) to mitigate congestion, provide sufficient space for reinforcement and grout consolidation (6.1.4), and maintain required reinforcement cover/protection (6.1.5.1) for corrosion protection. A minimum clearance between the reinforcement and the masonry unit of $^1/_4$ in. when using fine grout and $^1/_2$ in. when using coarse grout is required, however, TMS 602 Article 3.4 B allows horizontal reinforcement to be supported

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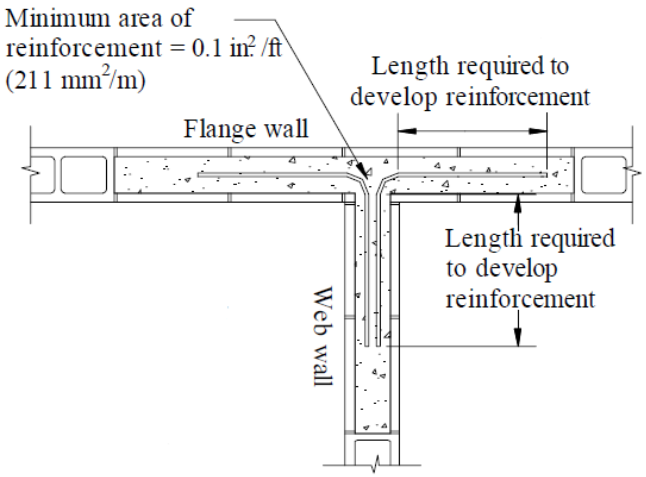
			directly by the cross webs of hollow units without maintaining this clearance requirement.
15	Where required, detail for continuity of bond beam at wall corners and intersections	TMS 402 Sec. 5.2.3 and 6.1.6.3	Continuity of bond beams may be required where intersecting walls are considered fanged. 
16	Minimum development and lap splice lengths	TMS 402 Sec. 6.1.6 and 6.1.7	Minimum development lengths and lap lengths vary with the clear cover to the nearest masonry surface or adjacent reinforcement, diameter of the reinforcement, yield strength of the reinforcement, and strength of the masonry (f'_m). A calculator for determining minimum lap and development lengths is available here: https://beautyofblock.com/2025/09/18/lap-splice-development-length-calculator/
SECTION 4: MINIMUM PRESCRIPTIVE DETAILING – INTERMEDIATE REINFORCED MASONRY SHEAR WALLS			
17	Provide minimum vertical reinforcement for intermediate reinforced masonry shear walls.	TMS 402 Sec. 7.3.2.4	At a minimum, vertical reinforcement in intermediate reinforced masonry shear walls consists of a minimum of one No. 4 reinforcing bar located at: • Corners; • Within 16 in. of each side of openings greater than 16 in. in length; • Within 8 in. of control joints; • Within 8 in. of the ends of walls; and • At a maximum spacing of 48 in. Reinforcement required to resist design loads can be used to meet the minimum prescriptive reinforcement requirements.
18	Provide minimum horizontal reinforcement for intermediate reinforced masonry shear walls.	TMS 402 Sec. 7.3.2.4	At a minimum, horizontal reinforcement in intermediate reinforced masonry shear walls consists of either: • Bond beams containing at least one No. 4 reinforcing bar spaced at a maximum of 120 in.; or • Two wires of 9 gauge (W1.7) joint reinforcement spaced at a maximum of 16 in. Horizontal reinforcement is also required: • At the top and bottom of openings greater than 16 in. in height and extending not less than 24 in. or $40d_b$ past the opening;

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			• At roof/floor diaphragms connected to the masonry; and • Within 16 in. of the top of the wall. Reinforcement required to resist design loads can be used to meet the minimum prescriptive reinforcement requirements.
19	When used, verify detailing of joint reinforcement used as shear reinforcement.	TMS 402 Sec. 7.4.1.2.1	In SDC A and B, joint reinforcement used to resist in-plane shear loads at a minimum is required to consist of two wires at least $^{3}/_{16}$ in. (W2.8) in diameter and spaced at no more than 16 in. on center. In SDC C, partially grouted shear walls may use two wires of 9 gauge joint reinforcement spaced at 8 in. instead of reinforced bond beams. In fully grouted shear walls assigned to SDC C, four wires of $^{3}/_{16}$ in. (W2.8) diameter joint reinforcement spaced at no more than 8 in. on center is permitted as an alternative to reinforced bond beams. Joint reinforcement having a diameter of $^{3}/_{16}$ in. is the largest wire reinforcement that can be placed in a $^{3}/_{8}$ in. mortar joint while maintaining minimum clearance requirements of TMS 602. Given the inability of this diameter wire to accommodate typical construction tolerances, it is rarely used in this application.
SECTION 5: GENERAL SEISMIC DESIGN CHECKS			
20	Verify interaction of structural and nonstructural components of the building.	TMS 402 Sec. 7.2.1	Nonstructural components of a building need to be isolated or have sufficient deformation compatibility with the lateral force-resisting system to accommodate displacement due to elastic and inelastic response. A common example of this condition would be at the top of partition walls supported at the top by a diaphragm so that loads are not inadvertently transferred to the partition and the partition can accommodate anticipated displacements of the lateral force-resisting system.
21	Verify design story drift limits.	TMS 402 Sec. 7.2.4	ASCE/SEI 7 stipulates drift limits for masonry structures subjected to earthquake loading. Per Section 7.2.4 of TMS 402, intermediate reinforced masonry shear walls are deemed to comply with these drift limits.
22	Verify components of the lateral force-resisting system in SDC C.	TMS 402 Sec. 7.4.3.2.4	For structures assigned to SDC C, masonry columns are limited to providing no more than 20% of the lateral stiffness along each line of lateral resistance at each story. If the structure is designed to remain elastic during a seismic event (e.g., R= 1.5), this limitation does not apply and the columns can be used to provide lateral load resistance to the structure.
23	Verify minimum detailing for elements supporting discontinuous members.	TMS 402 Sec. 7.4.3.2.5	Masonry beams, columns, or pilasters supporting discontinuous stiff members such as shear walls are required to meet additional minimum prescriptive detailing requirements.
24	Verify shear wall reinforcement meets maximum reinforcement limits (SD).	TMS 402 Sec. 9.3.5.6	To ensure intermediate reinforced masonry shear walls exhibit sufficient inelastic deformation capacity under lateral earthquake loading, the strength design provisions of TMS 402 stipulate options to: 1) limit the amount of reinforcement to ensure ductile response, 2) provided confined boundary elements at the ends of the shear wall, or 3) check that the wall under specified design loading has adequate ductility.

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			Where boundary elements are provided, testing may be required.
SECTION 6: INDUSTRY BEST PRACTICES			
25	Coordinate bond beam reinforcement with lintels at openings.	Best Practice	To avoid congestion and minimize material use, use bond beam reinforcement as flexural reinforcement above openings.
26	Detail control joints to maintain structural continuity and mitigate cracking.	CMHA TEC-009-25	Provide horizontal reinforcement and control joints or relief joints to mitigate cracking potential.

STANDARD	REFERENCE
ASTM	ASTM A615/A615M, ASTM A706/A706M, ASTM A951, ASTM C90, ASTM C270, ASTM C476, and ASTM C1714/C1714M.
TMS 402 – General	Sections 5.2.3, 6.1.3, 6.1.4, 6.1.5, 6.1.6, 6.1.7, 7.2.1, 7.2.4, 7.3.2.4, 7.4.1.2.1, 7.4.3.2.4, and 7.4.3.2.5.
TMS 402 – Allowable Stress Design	Sections 8.3.5.2.1 and 8.3.5
TMS 402 – Strength Design	Sections 9.1.9.2.1, 9.3.3.1.2 and 9.3.3.2.3,
TMS 602	Articles 1.4 B.2, 2.1 A, 2.2, 2.3 A, 2.4 A, 2.4 D,