ASD TABLES FOR REINFORCED CONCRETE MASONRY WALLS BASED ON THE 2012 IBC & 2011 MSJC

INTRODUCTION

The combination of concrete masonry and steel reinforcement provides a strong structural system capable of resisting large compressive and flexural loads. Reinforced masonry structures have significantly higher flexural strength and ductility than similarly configured unreinforced structures and provide greater reliability in terms of expected load carrying capacity at failure.

Concrete masonry elements can be designed using several methods in accordance with the *International Building Code* (IBC, ref. 1) and, by reference, *Building Code Requirements for Masonry Structures* (MSJC Code, ref. 2): allowable stress design, strength design, direct design, empirical design, or prestressed masonry. The design tables in this TEK are based on allowable stress design provisions.

The content presented in this edition of TEK 14-19B is based on the requirements of the 2012 IBC (ref. 1a), which in turn references the 2011 edition of the MSJC Code (ref. 2a). For designs based on the 2006 or 2009 IBC (refs. 1b, 1c), which reference the 2005 and 2008 MSJC (refs. 2b, 3c), respectively, the reader is referred to TEK 14-19B (ref. 3).

Significant changes were made to the allowable stress design (ASD) method between the 2009 and 2012 editions of the IBC. These are described in detail in TEK 14-07C, *ASD of Concrete Masonry (2012 IBC & 2011 MSJC)* (ref. 4), along with a detailed presentation of all of the allowable stress design provisions of the 2012 IBC.

LOAD TABLES

Tables 1 and 2 list the maximum bending moments and shears, respectively, imposed on walls simply supported at the top and bottom and subjected to uniform lateral loads with no applied axial loads.

WALL CAPACITY TABLES

Tables 3, 4, 5 and 6 contain the maximum bending moments and shear loads that can be sustained by 8-, 10-, 12-, and 16-in. (203-, 254-, 305-, 406 mm) walls, respectively, without exceeding the allowable stresses defined in the 2012 IBC and 2011 MSJC (refs. 1a, 2a). These wall strengths can be compared to the loads in Tables 1 and 2 to ensure the wall under consideration has sufficient design capacity to resist the applied load.

The values in Tables 3 through 6 are based on the following criteria:

- Maximum allowable stresses:
- $F_b = 0.45 f'_m$
- $F_v = 2\sqrt{f'_m}$
- F_s = 32,000 psi (220.7 MPa) (Grade 60)
- f'_m = 1500 psi (10.3 MPa)
- $E_m = 900f'_m$ or 1,350,000 psi (9,310 MPa)
- E_s = 29,000,000 psi (200,000 MPa)
- Type M or S mortar
- running bond or bond beams at 48 in. (1,219 mm) max o.c.
- reinforcement spacing does not exceed the wall height
- only cores containing reinforcement are grouted.

Reinforcing Steel Location

Two sets of tables are presented for each wall thickness. Tables 3a, 4a, 5a and 6a list resisting moment and resisting shear values for walls with the reinforcing steel located in the center of the wall. Centered reinforcing bars are effective for providing tensile resistance for walls which may be loaded from either side, such as an above grade exterior wall which is likely to experience both wind pressure and suction.

Tables 3b, 4b, 5b and 6b list resisting moment and resisting shear values for walls with the reinforcing steel offset from the center.

Table 1—Required Moment Strength for Walls Subjected to Uniform Lateral Loads

Wall ht., ft (m)	Required resisting moment, M, lb-in/ft (kN-m/m)[A] Uniform lateral load, psf (kPa)						
	5 (0.24)	15 (0.72)	20 (0.96)	25 (1.20)	30 (1.44)	35 (1.68)	45 (2.15)
8 (2.4)	480 (0.18)	1,440 (0.53)	1,920 (0.71)	2,400 (0.89)	2,880 (1.07)	3,360 (1.25)	4,320 (1.60)
12 (3.7)	1,080 (0.40)	3,240 (1.20)	4,320 (1.60)	5,400 (2.00)	6,480 (2.40)	7,560 (2.80)	9,720 (3.60)
16 (4.9)	1,920 (0.71)	5,760 (2.14)	7,680 (2.85)	9,600 (3.56)	11,500 (4.27)	13,400 (4.98)	17,300 (6.41)
20 (6.1)	3,000 (1.11)	9,000 (3.34)	12,000 (4.45)	15,000 (5.56)	18,000 (6.67)	21,000 (7.78)	27,000 (10.0)
24 (7.3)	4,320 (1.60)	13,000 (4.80)	17,300 (6.41)	21,600 (8.01)	25,900 (9.61)	30,200 (11.2)	38,900 (14.4)
28 (8.5)	5,880 (2.18)	17,600 (6.54)	23,500 (8.72)	29,400 (10.9)	35,300 (13.1)	41,200 (15.3)	52,900 (19.6)
32 (9.8)	7,680 (2.85)	23,000 (8.54)	30,700 (11.4)	38,400 (14.2)	46,100 (17.1)	53,800 (19.9)	69,100 (25.6)
36 (11.0)	9,720 (3.60)	29,200 (10.81)	38,900 (14.4)	48,600 (18.0)	58,300 (21.6)	68,000 (25.2)	87,500 (32.4)
40 (12.2)	12,000 (4.45)	36,000 (13.34)	48,000 (17.8)	60,000 (22.2)	72,000 (26.7)	84,000 (31.1)	108,000 (40.0)

[A] Based on walls simply supported at top and bottom, no axial load.

Table 2—Required Shear Strength for Walls Subjected to Uniform Lateral Loads

Wall ht., ft (m)	Required resisting shear, V, lb/ft (kN/m)[A] Uniform lateral load, psf (kPa)						
	5 (0.24)	15 (0.72)	20 (0.96)	25 (1.20)	30 (1.44)	35 (1.68)	45 (2.15)
8 (2.4)	20 (0.29)	60 (0.88)	80 (1.17)	100 (1.46)	120 (1.75)	140 (2.04)	180 (2.63)
12 (3.7)	30 (0.44)	90 (1.31)	120 (1.75)	150 (2.19)	180 (2.63)	210 (3.07)	270 (3.94)
16 (4.9)	40 (0.58)	120 (1.75)	160 (2.34)	200 (2.92)	240 (3.50)	280 (4.09)	360 (5.25)
20 (6.1)	50 (0.73)	150 (2.19)	200 (2.92)	250 (3.65)	300 (4.38)	350 (5.11)	450 (6.57)
24 (7.3)	60 (0.88)	180 (2.63)	240 (3.50)	300 (4.38)	360 (5.25)	420 (6.13)	540 (7.88)
28 (8.5)	70 (1.02)	210 (3.07)	280 (4.09)	350 (5.11)	420 (6.13)	490 (7.15)	630 (9.19)
32 (9.8)	80 (1.17)	240 (3.50)	320 (4.67)	400 (5.84)	480 (7.01)	560 (8.17)	720 (10.5)
36 (11.0)	90 (1.31)	270 (3.94)	360 (5.25)	450 (6.57)	540 (7.88)	630 (9.19)	810 (11.8)
40 (12.2)	100 (1.46)	300 (4.38)	400 (5.84)	500 (7.30)	600 (8.76)	700 (10.2)	900 (13.1)

[A] Based on walls simply supported at top and bottom, no axial load.

Placing the reinforcement farther from the compression face of the masonry provides a larger effective depth of reinforcement, *d*, and correspondingly larger capacities. A single layer of off-center reinforcement can be used in situations where the wall is loaded from one side only, such as a basement wall with the reinforcement located towards the interior. For walls where loads can be in both directions (i.e. pressure or suction), two layers of reinforcement are used: one towards the wall exterior and one towards the interior to provide increased capacity under both loading conditions. In Tables 3b, 4b, 5b and 6b, the effective depth of reinforcement, *d*, is a practical value which takes into account construction tolerances and the reinforcing bar diameter.

Figure 1 illustrates the two steel location cases.

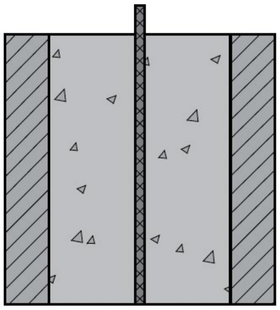
DESIGN EXAMPLE

A warehouse wall will span 34 ft (10.4 m) between the floor slab and roof diaphragm. The walls will be constructed using 12 in. (305 mm) concrete masonry units. What is the required reinforcing steel size and spacing to support a wind load of 20 psf (0.96 kPa)?

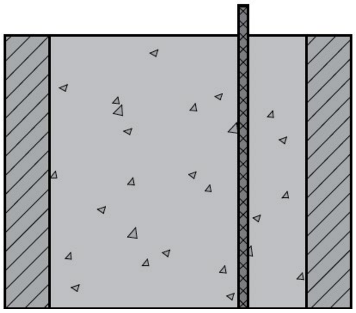
From interpolation of Tables 1 and 2, respectively, the wall must be able to resist:

M = 34,800 lb-in./ft (12.9 kN-m/m)

V = 340 lb/ft (4.96 kN/m)



Reinforcement located in the center of the wall (see Tables 3a, 4a, 5a and 6a)



Reinforcement located towards the tension side of the wall (see Tables 3b, 4b, 5b and 6b)

Figure 1—Reinforcing Steel Locations

Assuming the use of offset reinforcement, from Table 5b, No. 6 bars at 40 in. on center (M#19 at 1,016 mm) or No. 7 bars at 48 in. (M#22 at 1,219 mm) on center provides sufficient strength:

for No. 6 bars at 40 in. o.c. (M#19 at 1,016 mm):

M_r = 35,686 lb-in./ft (13.3 kN-m/m) > M OK

V_r = 2,299 lb/ft (33.5 kN/m) > V OK

for No. 7 bars at 48 in. (M#22 at 1,219 mm) :

M_r = 40,192 lb-in./ft (14.9 kN-m/m) > M OK

V_r = 2,133 lb/ft (31.1 kN/m) > V OK

As discussed above, since wind loads can act in either direction, two bars must be provided in each cell when using off-center reinforcement—one close to each faceshell.

Alternatively, No. 6 bars at 24 in (M#19 at 610 mm) or No. 8 at 40 in (M#25 at 1,016 mm) could have been used in the center of the wall.

NOTATION

A_s = area of nonprestressed longitudinal reinforcement, in.^{2} (mm^2)
b = effective compressive width per bar, in. (mm)
d = distance from extreme compression fiber to centroid of tension reinforcement, in. (mm)
E_m = modulus of elasticity of masonry in compression, psi (MPa)
E_s = modulus of elasticity of steel, psi (MPa)
F_b = allowable compressive stress available to resist flexure only, psi (MPa)
F_s = allowable tensile or compressive stress in reinforcement, psi (MPa)
F_v = allowable shear stress, psi (MPa)
f'_m = specified compressive strength of masonry, psi (MPa)
M = maximum calculated bending moment at section under consideration, in.-lb, (N-mm)
M_r = flexural strength (resisting moment), in.-lb (N-mm)
V = shear force, lb (N)
V_r = shear capacity (resisting shear) of masonry, lb (N)

Table 3—Allowable Stress Design Capacities for 8-in. (203-mm) Walls[A]

3a: 8-in. (203 mm) wall with reinforcement centered in the wall

Bar size No.	Bar spacing, in.	A_s, in^2/ft	d, in.	M_r, lb-in/ft	V_r, lb/ft	Bar size No.	Bar spacing, in.	A_s, in^2/ft	d, in.	M_r, lb-in/ft	V_r, lb/ft
8	8	1.178		29,511	3,987	7	48	0.150		16,400	1,771
7	8	0.902		27,873	3,987	6	40	0.133		14,518	1,864
6	8	0.663		25,922	3,987	6	48	0.110		12,195	1,771
8	16	0.589		24,374	2,699	4	24	0.098		11,130	2,235
5	8	0.460		23,640	3,987	5	40	0.092		10,381	1,864
7	16	0.451		22,900	2,699	5	48	0.077		8,712	1,771
8	24	0.393		22,013	2,235	6	72	0.074		8,130	1,181
6	16	0.331		21,141	2,699	4	40	0.059		6,805	1,864
4	8	0.295	3.813	20,946	3,987	6	96	0.055	3.813	6,097	886
7	24	0.301		20,370	2,235	5	72	0.051		5,808	1,181
8	40	0.236		19,144	1,864	4	48	0.049		5,705	1,771
5	16	0.230		19,071	2,699	6	120	0.044		4,878	708
6	24	0.221		18,726	2,235	5	96	0.038		4,356	886
8	48	0.196		18,079	1,771	4	72	0.033		3,803	1,181
7	40	0.180		17,526	1,864	5	120	0.031		3,485	708
5	24	0.153		16,625	2,235	4	96	0.025		2,852	886
4	16	0.147		16,400	2,699	4	120	0.020		2,282	708

3b: 8-in. (203 mm) wall with offset reinforcement

Bar size No.	Bar spacing, in.	A_s, in^2/ft	d, in.	M_r, lb-in/ft	V_r, lb/ft	Bar size No.	Bar spacing, in.	A_s, in^2/ft	d, in.	M_r, lb-in/ft	V_r, lb/ft
8	8	1.178	4.875	45,867	3,987	4	16	0.147	5.125	24,462	2,699
7	8	0.902	4.938	44,032	3,987	6	40	0.133	5.000	20,666	1,864
6	8	0.663	5.000	41,552	3,987	6	48	0.110	5.000	17,426	1,771
5	8	0.460	5.063	38,393	3,987	4	24	0.098	5.125	16,706	2,235
8	16	0.589	4.875	36,327	2,699	5	40	0.092	5.063	15,201	1,864
7	16	0.451	4.938	34,776	2,699	5	48	0.077	5.063	12,750	1,771
4	8	0.295	5.125	34,091	3,987	6	72	0.074	5.000	11,617	1,181
6	16	0.331	5.000	32,726	2,699	4	40	0.059	5.125	10,200	1,864
8	24	0.393	4.875	32,439	2,235	6	96	0.055	5.000	8,713	886
7	24	0.301	4.938	30,902	2,235	4	48	0.049	5.125	8,546	1,771
5	16	0.230	5.063	30,126	2,699	5	72	0.051	5.063	8,500	1,181
6	24	0.221	5.000	28,877	2,235	6	120	0.044	5.000	6,970	708
8	40	0.236	4.875	28,232	1,864	5	96	0.038	5.063	6,375	886
8	48	0.196	4.875	26,754	1,771	4	72	0.033	5.125	5,698	1,181
7	40	0.180	4.938	25,663	1,864	5	120	0.031	5.063	5,100	708
5	24	0.153	5.063	22,792	2,235	4	96	0.025	5.125	4,273	886
7	48	0.150	4.938	21,514	1,771	4	120	0.020	5.125	3,419	708

[A] Metric equivalents can be obtained by applying the following conversion factors:
in. x 25.4 = mm lb-in./ft x 0.0003707 = kN-m/m
in.^{2}/ft x 2,117 = mm^2/m lb/ft x 0.01459 = kN/m

[B] For reinforcement spacings exceeding six times the wall thickness (the effective compressive width of masonry *b* for each reinforcing bar), prudent engineering practice dictates that the masonry between these sections be designed to span this horizontal distance.

Table 4—Allowable Stress Design Capacities for 10-in. (254-mm) Walls[A]

4a: 10-in. (254 mm) wall with reinforcement centered in the wall

Bar size No.	Bar spacing, in.	A_s, in²/ft	d, in.	M_r, lb-in/ft	V_r, lb/ft	Bar size No.	Bar spacing, in.	A_s, in²/ft	d, in.	M_r, lb-in/ft	V_r, lb/ft
9	8	1.491		47,047	5,032	7	48	0.150		20,940	1,952
8	8	1.178		44,823	5,032	6	40	0.133		18,514	2,081
7	8	0.902		42,091	5,032	6	48	0.110		15,539	1,952
6	8	0.663		38,893	5,032	4	24	0.098		14,178	2,597
9	16	0.746		37,375	3,243	5	40	0.092		13,221	2,081
8	16	0.589		35,582	3,243	5	48	0.077		11,088	1,952
5	8	0.460		35,225	5,032	6	72	0.074		10,446	1,519
9	24	0.497		33,500	2,597	4	40	0.059		8,654	2,081
8	24	0.393	4.813	31,796	2,597	6	96	0.055	4.813	7,834	1,140
4	8	0.295		30,696	5,032	5	72	0.051		7,445	1,519
7	24	0.301		29,692	2,597	4	48	0.049		7,250	1,952
9	48	0.249		28,044	1,952	6	120	0.044		6,267	912
8	40	0.236		27,675	2,081	5	96	0.038		5,584	1,140
6	24	0.221		27,196	2,597	4	72	0.033		4,863	1,519
8	48	0.196		26,221	1,952	5	120	0.031		4,467	912
7	40	0.180		24,972	2,081	4	96	0.025		3,647	1,140
5	24	0.153		21,608	2,597	4	120	0.020		2,918	912

4b: 10-in. (254 mm) wall with offset reinforcement

Bar size No.	Bar spacing, in.	A_s, in²/ft	d, in.	M_r, lb-in/ft	V_r, lb/ft	Bar size No.	Bar spacing, in.	A_s, in²/ft	d, in.	M_r, lb-in/ft	V_r, lb/ft
9	8	1.500	6.811	87,591	5,032	7	48	0.150	6.938	30,805	1,952
8	8	1.178	6.875	84,202	5,032	6	40	0.133	7.000	27,432	2,081
7	8	0.902	6.938	79,618	5,032	6	48	0.110	7.000	22,957	1,952
6	8	0.663	7.000	73,983	5,032	4	24	0.098	7.125	21,299	2,597
5	8	0.460	7.063	67,305	5,032	5	40	0.092	7.063	19,666	2,081
9	16	0.750	6.811	65,094	3,243	5	48	0.077	7.063	16,467	1,952
8	16	0.589	6.875	62,660	3,243	6	72	0.074	7.000	15,387	1,519
4	8	0.295	7.125	58,797	5,032	4	40	0.059	7.125	12,954	2,081
9	24	0.333	6.811	56,846	2,597	6	96	0.055	7.000	11,540	1,140
8	24	0.393	6.875	54,713	2,597	5	72	0.051	7.063	11,045	1,519
7	24	0.301	6.938	51,859	2,597	4	48	0.049	7.125	10,844	1,952
8	40	0.236	6.875	47,272	2,081	6	120	0.044	7.000	9,232	912
9	48	0.250	6.811	47,039	1,952	5	96	0.038	7.063	8,284	1,140
6	24	0.221	7.000	45,081	2,597	4	72	0.033	7.125	7,265	1,519
8	48	0.196	6.875	39,950	1,952	5	120	0.031	7.063	6,627	912
7	40	0.180	6.938	36,810	2,081	4	96	0.025	7.125	5,449	1,140
5	24	0.153	7.063	32,356	2,597	4	120	0.020	7.125	4,359	912

[A] Metric equivalents can be obtained by applying the following conversion factors:
in. x 25.4 = mm   lb-in./ft x 0.0003707 = kN-m/m
in.²/ft x 2,117 = mm²/m   lb/ft x 0.01459 = kN/m

[B] For reinforcement spacings exceeding six times the wall thickness (the effective compressive width of masonry *b* for each reinforcing bar), prudent engineering practice dictates that the masonry between these sections be designed to span this horizontal distance.

Table 5—Allowable Stress Design Capacities for 12-in. (305-mm) Walls[A]

5a: 12-in. (305 mm) wall with reinforcement centered in the wall

Bar size No.	Bar spacing, in.	A_s, in^2/ft	d, in.	M_r, lb-in/ft	V_r, lb/ft	Bar size No.	Bar spacing, in.	A_s, in^2/ft	d, in.	M_r, lb-in/ft	V_r, lb/ft
9	8	1.491		66,047	6,078	7	48	0.150		25,559	2,133
8	8	1.178		62,670	6,078	6	40	0.133		22,567	2,299
7	8	0.902		58,576	6,078	6	48	0.110		18,908	2,133
6	8	0.663		53,853	6,078	4	24	0.098		17,241	2,960
9	16	0.746		50,600	3,786	5	40	0.092		16,073	2,299
5	8	0.460		48,513	6,078	5	48	0.077		13,474	2,133
8	16	0.589		48,085	3,786	6	72	0.074		12,771	1,858
9	24	0.497		44,751	2,960	4	40	0.059		10,510	2,299
8	24	0.393	5.813	42,484	2,960	6	96	0.055	5.813	9,578	1,393
4	8	0.295		42,019	6,078	5	72	0.051		9,087	1,858
7	24	0.301		39,714	2,960	4	48	0.049		8,802	2,133
9	48	0.249		37,292	2,133	6	120	0.044		7,663	1,115
8	40	0.236		36,885	2,299	5	96	0.038		6,815	1,393
6	24	0.221		36,459	2,960	4	72	0.033		5,924	1,858
8	48	0.196		33,425	2,133	5	120	0.031		5,452	1,115
7	40	0.180		30,521	2,299	4	96	0.025		4,443	1,393
5	24	0.153		26,364	2,960	4	120	0.020		3,555	1,115

5b: 12-in. (305 mm) wall with offset reinforcement

Bar size No.	Bar spacing, in.	A_s, in^2/ft	d, in.	M_r, lb-in/ft	V_r, lb/ft	Bar size No.	Bar spacing, in.	A_s, in^2/ft	d, in.	M_r, lb-in/ft	V_r, lb/ft
9	8	1.500	8.811	137,877	6,078	7	48	0.150	8.938	40,192	2,133
8	8	1.178	8.875	131,323	6,078	6	40	0.133	9.000	35,686	2,299
7	8	0.902	8.938	122,983	6,078	6	48	0.110	9.000	29,839	2,133
6	8	0.663	9.000	113,163	6,078	4	24	0.098	9.125	27,535	2,960
5	8	0.460	9.063	101,938	6,078	5	40	0.092	9.063	25,477	2,299
9	16	0.750	8.811	97,676	3,786	5	48	0.077	9.063	21,301	2,133
8	16	0.589	8.875	93,382	3,786	6	72	0.074	9.000	20,034	1,858
9	24	0.333	8.811	83,402	2,960	4	40	0.059	9.125	16,691	2,299
8	24	0.393	8.875	79,903	2,960	6	96	0.055	9.000	15,026	1,393
4	8	0.295	9.125	79,154	6,078	5	72	0.051	9.063	14,319	1,858
7	24	0.301	8.938	75,450	2,960	4	48	0.049	9.125	13,964	2,133
9	48	0.250	8.811	65,395	2,133	6	120	0.044	9.000	12,021	1,115
8	40	0.236	8.875	62,450	2,299	5	96	0.038	9.063	10,739	1,393
6	24	0.221	9.000	58,672	2,960	4	72	0.033	9.125	9,383	1,858
8	48	0.196	8.875	52,286	2,133	5	120	0.031	9.063	8,591	1,115
7	40	0.180	8.938	48,042	2,299	4	96	0.025	9.125	7,037	1,393
5	24	0.153	9.063	41,992	2,960	4	120	0.020	9.125	5,630	1,115

[A] Metric equivalents can be obtained by applying the following conversion factors:
in. x 25.4 = mm   lb-in./ft x 0.0003707 = kN-m/m
in.^{2}/ft x 2,117 = mm^2/m   lb/ft x 0.01459 = kN/m

[B] For reinforcement spacings exceeding six times the wall thickness (the effective compressive width of masonry *b* for each reinforcing bar), prudent engineering practice dictates that the masonry between these sections be designed to span this horizontal distance.

Table 6—Allowable Stress Design Capacities for 16-in. (406-mm) Walls[A]

6a: 16-in. (406 mm) wall with reinforcement centered in the wal6

Bar size No.	Bar spacing, in.	A_s, in^2/ft	d, in.	M_r, lb-in/ft	V_r, lb/ft	Bar size No.	Bar spacing, in.	A_s, in^2/ft	d, in.	M_r, lb-in/ft	V_r, lb/ft
9	8	1.491		111,627	8,170	7	48	0.150		34,905	2,496
8	8	1.178		105,260	8,170	6	40	0.133		30,779	2,733
7	8	0.902		97,689	8,170	6	48	0.110		25,746	2,496
6	8	0.663		89,134	8,170	4	24	0.098		23,437	3,684
9	16	0.746		80,840	4,872	5	40	0.092		21,839	2,733
5	8	0.460		79,661	8,170	5	48	0.077		18,273	2,496
8	16	0.589		76,548	4,872	6	72	0.074		17,314	2,099
9	24	0.497		69,772	3,684	4	40	0.059		14,237	2,733
4	8	0.295	7.813	67,291	8,170	6	96	0.055	7.813	12,985	1,575
8	24	0.393		66,184	3,684	5	72	0.051		12,303	2,099
7	24	0.301		61,882	3,684	4	48	0.049		11,915	2,496
9	48	0.249		57,254	2,496	6	120	0.044		10,388	1,260
8	40	0.236		54,618	2,733	5	96	0.038		9,227	1,575
6	24	0.221		50,598	3,684	4	72	0.033		8,011	2,099
8	48	0.196		45,727	2,496	5	120	0.031		7,382	1,260
7	40	0.180		41,718	2,733	4	96	0.025		6,008	1,575
5	24	0.153		35,965	3,684	4	120	0.020		4,806	1,260

6b: 16-in. (406 mm) wall with offset reinforcement

Bar size No.	Bar spacing, in.	A_s, in^2/ft	d, in.	M_r, lb-in/ft	V_r, lb/ft	Bar size No.	Bar spacing, in.	A_s, in^2/ft	d, in.	M_r, lb-in/ft	V_r, lb/ft
9	8	1.500	12.811	263,890	8,170	7	48	0.150	12.938	59,041	2,496
8	8	1.178	12.875	248,478	8,170	6	40	0.133	13.000	52,269	2,733
7	8	0.902	12.938	229,922	8,170	6	48	0.110	13.000	43,693	2,496
6	8	0.663	13.000	208,999	8,170	4	24	0.098	13.125	40,078	3,684
9	16	0.750	12.811	175,484	4,872	5	40	0.092	13.063	37,184	2,733
5	8	0.460	13.063	175,003	8,170	5	48	0.077	13.063	31,064	2,496
8	16	0.589	12.875	166,221	4,872	6	72	0.074	13.000	29,278	2,099
9	24	0.333	12.811	144,735	3,684	4	40	0.059	13.125	24,237	2,733
8	24	0.393	12.875	137,713	3,684	6	96	0.055	13.000	21,959	1,575
4	8	0.295	13.125	115,581	8,170	5	72	0.051	13.063	20,811	2,099
7	24	0.301	12.938	115,516	3,684	4	48	0.049	13.125	20,245	2,496
9	48	0.250	12.811	96,550	2,496	6	120	0.044	13.000	17,567	1,260
8	40	0.236	12.875	91,944	2,733	5	96	0.038	13.063	15,608	1,575
6	24	0.221	13.000	85,901	3,684	4	72	0.033	13.125	13,576	2,099
8	48	0.196	12.875	77,012	2,496	5	120	0.031	13.063	12,487	1,260
7	40	0.180	12.938	70,565	2,733	4	96	0.025	13.125	10,182	1,575
5	24	0.153	13.063	61,323	3,684	4	120	0.020	13.125	8,145	1,260

A Metric equivalents can be obtained by applying the following conversion factors:
in. x 25.4 = mm   lb-in./ft x 0.0003707 = kN-m/m
in.^{2}/ft x 2,117 = mm^2/m   lb/ft x 0.01459 = kN/m

B For reinforcement spacings exceeding six times the wall thickness (the effective compressive width of masonry *b* for each reinforcing bar), prudent engineering practice dictates that the masonry between these sections be designed to span this horizontal distance.

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The Concrete Masonry & Hardscapes Association (CMHA) represents a unification of the Interlocking Concrete Pavement Institute (ICPI) and National Concrete Masonry Association (NCMA). CMHA is a trade association representing US and Canadian producers and suppliers in the concrete masonry and hardscape industry, as well as contractors of interlocking concrete pavement and segmental retaining walls. CMHA is the authority for segmental concrete products and systems, which are the best value and preferred choice for resilient pavement, structures, and living spaces. CMHA is dedicated to the advancement of these building systems through research, promotion, education, and the development of manufacturing guides, design codes and resources, testing standards, and construction practices.

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