

SECTION PROPERTIES OF CONCRETE MASONRY WALLS

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INTRODUCTION

Engineered design of concrete masonry uses section properties to determine strength, stiffness and deflection characteristics. These design philosophies are summarized in *Allowable Stress Design of Concrete Masonry*, *Strength Design of Concrete Masonry* and *Post-Tensioned Concrete Masonry Wall Design* (refs. 1, 2, 3).

SECTION PROPERTIES

Tables 1 through 13 summarize section properties of grouted and ungrouted 4-, 6-, 8-, 10-, 12-, 14- and 16-in. (102-, 152-, 203-, 254-, 305-, 356- and 406-mm) wide concrete masonry walls, based on:

- standard unit dimensions are based on the minimum face shell and web thickness requirements of *Standard Specification for Loadbearing Concrete Masonry Units*, ASTM C 90-06 (ref. 4) as shown in Figure 1, except as noted in Tables 8 through 13. Note that prior to ASTM C 90-06, two minimum face shell thicknesses for units 10-in. (254-mm) and wider were specified. With the introduction of ASTM C 90-06, the two face shell thicknesses were replaced with one minimum thickness requirement (1 1/4 in. (32 mm)). See Reference 5 for further information. Tables 10 through 13 can be used for section properties of units complying with previous editions of ASTM C 90.
- the nominal face dimensions of all units are 16 in. long by 8 in. high (406 by 203 mm),
- all mortar joints are 3/8 in. (9.5 mm) thick,
- all mortar joints are the same depth as the thickness of the face shell or web on which they are placed,
- for ungrouted and partially grouted masonry, all units have a symmetrical cross-section, square ends and two cores (with the exception of architectural features such as scores, ribs and split surfaces). Note that the section properties listed can be con-

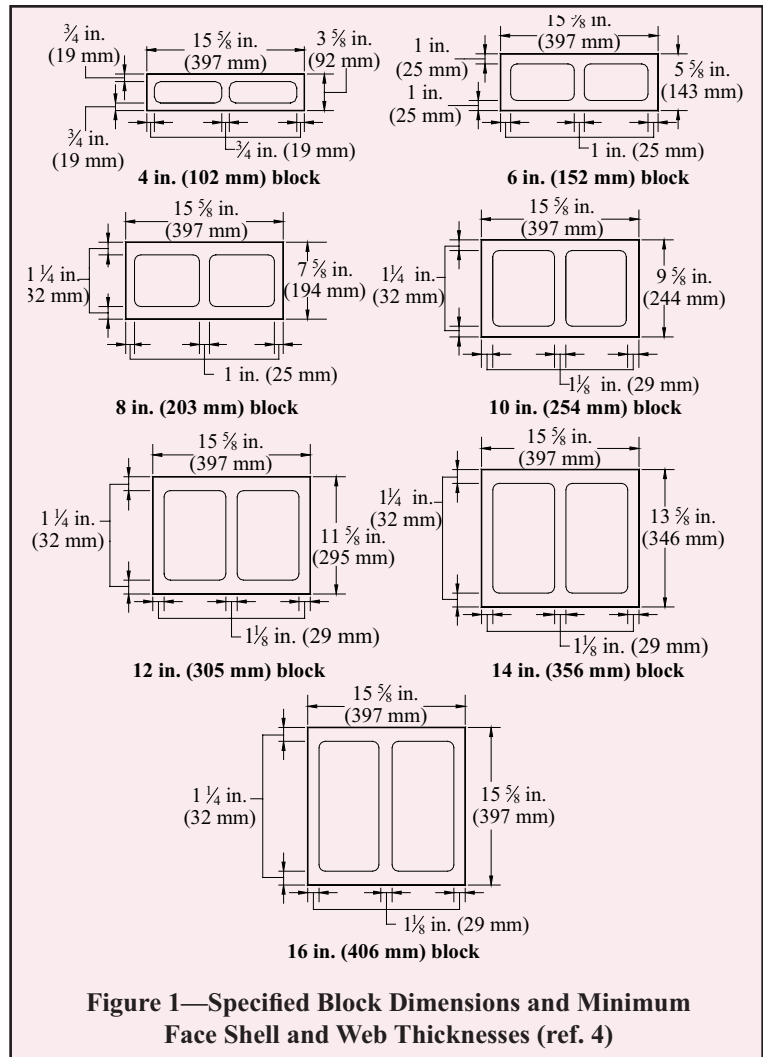


Figure 1—Specified Block Dimensions and Minimum Face Shell and Web Thicknesses (ref. 4)

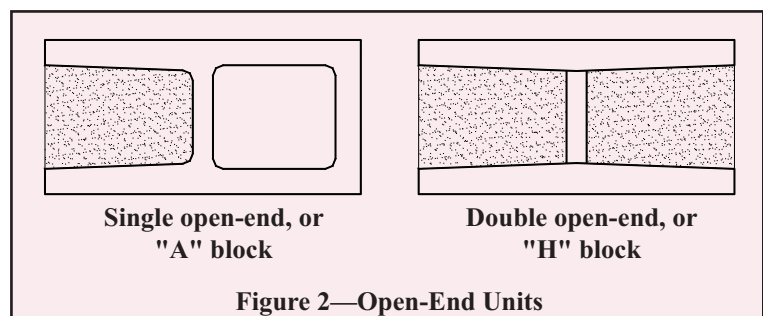


Figure 2—Open-End Units

servatively applied to open-end units (see Figure 2) that are either partially grouted or solid grouted, since by code the cells with the open end must be grouted.

The tables include both net and average properties. Net section properties (A_n , I_n and S_n) are calculated based on the minimum net cross-sectional area of an assemblage. These values are related to the critical section when determining stresses due to an applied load (refs. 6, 7). Average section properties (A_{avg} , I_{avg} , S_{avg} and r_{avg}) correspond to an average cross-sectional area of an assemblage, and are used to determine stiffness or deflection due to applied loading (refs. 6, 7).

The net and average horizontal section properties are listed in Tables 1a, 2a, etc., while vertical section properties are listed in Tables 1b, 2b, etc. For vertically spanning walls, horizontal section properties are calculated along a horizontal axis parallel to the plane of the masonry (axis X-X in Figure 3). For horizontally spanning walls, vertical section properties

are calculated along a vertical axis parallel to the plane of the masonry (axis Y-Y in Figure 3).

In addition to section properties based on the standard unit dimensions shown in Figure 1, Tables 8 and 9 list section properties of walls constructed using 8-in. (203-mm) units with thickened face shells. These units are often specified to achieve higher fire ratings. Table 10 lists section properties of walls constructed using 10-in. (254-mm) units with 1³/₈ in. (35 mm) face shells, the minimum required prior to ASTM C-90-06. Similarly, Tables 11, 12 and 13 list section properties of walls constructed using 12-, 14- and 16-in. (305-, 356- and 406-mm) units, respectively, with 1¹/₂ in. (38 mm) face shells.

METRIC CONVERSIONS:	in.	x	25.4	=	mm
	in. ² /ft	x	2,117	=	mm ² /m
	in. ³ /ft	x	53,763	=	mm ³ /m
	in. ⁴ /ft	x	1,365,588	=	mm ⁴ /m

Table 1—4-inch (102-mm) Single Wythe Walls, 3/4 in. (19 mm) Face Shells (standard)^C

1a: Horizontal Section Properties (Masonry Spanning Vertically)									
Unit	Grout spacing (in.)	Mortar bedding	Net cross-sectional properties ^A			Average cross-sectional properties ^B			
			A_n (in. ² /ft)	I_n (in. ⁴ /ft)	S_n (in. ³ /ft)	A_{avg} (in. ² /ft)	I_{avg} (in. ⁴ /ft)	S_{avg} (in. ³ /ft)	r_{avg} (in.)
Hollow	No grout	Face shell	18.0	38.0	21.0	21.6	39.4	21.7	1.35
Hollow	No grout	Full	21.6	39.4	21.7	21.6	39.4	21.7	1.35
100% solid/solidly grouted		Full	43.5	47.6	26.3	43.5	47.6	26.3	1.05
1b: Vertical Section Properties (Masonry Spanning Horizontally)									
Hollow	No grout	Face shell	18.0	38.0	21.0	21.2	39.1	21.6	1.36
Hollow	No grout	Full	18.0	38.0	21.0	21.6	39.4	21.7	1.35
100% solid/solidly grouted		Full	43.5	47.6	26.3	43.5	47.6	26.3	1.05

Table 2—6-inch (152-mm) Single Wythe Walls, 1 in. (25 mm) Face Shells (standard)

2a: Horizontal Section Properties (Masonry Spanning Vertically)									
Unit	Grout spacing (in.)	Mortar bedding	Net cross-sectional properties ^A			Average cross-sectional properties ^B			
			A_n (in. ² /ft)	I_n (in. ⁴ /ft)	S_n (in. ³ /ft)	A_{avg} (in. ² /ft)	I_{avg} (in. ⁴ /ft)	S_{avg} (in. ³ /ft)	r_{avg} (in.)
Hollow	No grout	Face shell	24.0	130.3	46.3	32.2	139.3	49.5	2.08
Hollow	No grout	Full	32.2	139.3	49.5	32.2	139.3	49.5	2.08
100% solid/solidly grouted		Full	67.5	178.0	63.3	67.5	178.0	63.3	1.62
Hollow	16	Face shell	46.6	155.1	55.1	49.3	158.1	56.2	1.79
Hollow	24	Face shell	39.1	146.8	52.2	43.6	151.8	54.0	1.87
Hollow	32	Face shell	35.3	142.7	50.7	40.7	148.7	52.9	1.91
Hollow	40	Face shell	33.0	140.2	49.9	39.0	146.8	52.2	1.94
Hollow	48	Face shell	31.5	138.6	49.3	37.9	145.5	51.7	1.96
Hollow	72	Face shell	29.0	135.8	48.3	36.0	143.5	51.0	2.00
Hollow	96	Face shell	27.8	134.5	47.8	35.0	142.4	50.6	2.02
Hollow	120	Face shell	27.0	133.6	47.5	34.4	141.8	50.4	2.03
2b: Vertical Section Properties (Masonry Spanning Horizontally)									
Hollow	No grout	Face shell	24.0	130.3	46.3	31.4	137.7	49.0	2.09
Hollow	No grout	Full	24.0	130.3	46.3	32.2	139.3	49.5	2.08
100% solid/solidly grouted		Full	67.5	178.0	63.3	67.5	178.0	63.3	1.62
Hollow	16	Face shell	45.8	154.2	54.8	53.1	161.5	57.4	1.74
Hollow	24	Face shell	38.5	146.2	52.0	45.9	153.6	54.6	1.83
Hollow	32	Face shell	34.9	142.3	50.6	42.3	149.6	53.2	1.88
Hollow	40	Face shell	32.7	139.9	49.7	40.1	147.2	52.4	1.92
Hollow	48	Face shell	31.3	138.3	49.2	38.6	145.7	51.8	1.94
Hollow	96	Face shell	27.6	134.3	47.8	35.0	141.7	50.4	2.01
Hollow	120	Face shell	26.9	133.5	47.5	34.3	140.9	50.1	2.03

Table 3—8-inch (203-mm) Single Wythe Walls, 1¼ in. (32 mm) Face Shells (standard)

3a: Horizontal Section Properties (Masonry Spanning Vertically)									
Unit	Grout spacing (in.)	Mortar bedding	Net cross-sectional properties ^A			Average cross-sectional properties ^B			
			A_n (in. ² /ft)	I_n (in. ⁴ /ft)	S_n (in. ³ /ft)	A_{avg} (in. ² /ft)	I_{avg} (in. ⁴ /ft)	S_{avg} (in. ³ /ft)	r_{avg} (in.)
Hollow	No grout	Face shell	30.0	308.7	81.0	41.5	334.0	87.6	2.84
Hollow	No grout	Full	41.5	334.0	87.6	41.5	334.0	87.6	2.84
100% solid/solidly grouted		Full	91.5	443.3	116.3	91.5	443.3	116.3	2.20
Hollow	16	Face shell	62.0	378.6	99.3	65.8	387.1	101.5	2.43
Hollow	24	Face shell	51.3	355.3	93.2	57.7	369.4	96.9	2.53
Hollow	32	Face shell	46.0	343.7	90.1	53.7	360.5	94.6	2.59
Hollow	40	Face shell	42.8	336.7	88.3	51.2	355.2	93.2	2.63
Hollow	48	Face shell	40.7	332.0	87.1	49.6	351.7	92.2	2.66
Hollow	72	Face shell	37.1	324.3	85.0	46.9	345.8	90.7	2.71
Hollow	96	Face shell	35.3	320.4	84.0	45.6	342.8	89.9	2.74
Hollow	120	Face shell	34.3	318.0	83.4	44.8	341.0	89.5	2.76
3b: Vertical Section Properties (Masonry Spanning Horizontally)									
Hollow	No grout	Face shell	30.0	308.7	81.0	40.5	330.1	86.6	2.86
Hollow	No grout	Full	30.0	308.7	81.0	41.5	334.0	87.6	2.84
100% solid/solidly grouted		Full	91.5	443.3	116.3	91.5	443.3	116.3	2.20
Hollow	16	Face shell	60.8	376.0	98.6	71.2	397.4	104.2	2.36
Hollow	24	Face shell	50.5	353.6	92.7	61.0	374.9	98.3	2.48
Hollow	32	Face shell	45.4	342.4	89.8	55.8	363.7	95.4	2.55
Hollow	40	Face shell	42.3	335.6	88.0	52.8	357.0	93.6	2.60
Hollow	48	Face shell	40.3	331.1	86.9	50.7	352.5	92.5	2.64
Hollow	96	Face shell	35.1	319.9	83.9	45.6	341.3	89.5	2.74
Hollow	120	Face shell	34.1	317.7	83.3	44.6	339.0	88.9	2.76

Table 4—10-inch (254-mm) Single Wythe Walls, 1¼ in. (32 mm) Face Shells (standard)

4a: Horizontal Section Properties (Masonry Spanning Vertically)									
Unit	Grout spacing (in.)	Mortar bedding	Net cross-sectional properties ^A			Average cross-sectional properties ^B			
			A_n (in. ² /ft)	I_n (in. ⁴ /ft)	S_n (in. ³ /ft)	A_{avg} (in. ² /ft)	I_{avg} (in. ⁴ /ft)	S_{avg} (in. ³ /ft)	r_{avg} (in.)
Hollow	No grout	Face shell	30.0	530.0	110.1	48.0	606.3	126.0	3.55
Hollow	No grout	Full	48.0	606.3	126.0	48.0	606.3	126.0	3.55
100% solid/solidly grouted		Full	115.5	891.7	185.3	115.5	891.7	185.3	2.78
Hollow	16	Face shell	74.8	719.3	149.5	80.8	744.7	154.7	3.04
Hollow	24	Face shell	59.8	656.2	136.3	69.9	698.6	145.2	3.16
Hollow	32	Face shell	52.4	624.6	129.8	64.4	675.5	140.4	3.24
Hollow	40	Face shell	47.9	605.7	125.9	61.1	661.6	137.5	3.29
Hollow	48	Face shell	44.9	593.1	123.2	58.9	652.4	135.6	3.33
Hollow	72	Face shell	39.9	572.0	118.9	55.3	637.0	132.4	3.39
Hollow	96	Face shell	37.5	561.5	116.7	53.5	629.3	130.8	3.43
Hollow	120	Face shell	36.0	555.2	115.4	52.4	624.7	129.8	3.45
4b: Vertical Section Properties (Masonry Spanning Horizontally)									
Hollow	No grout	Face shell	30.0	530.0	110.1	46.3	597.4	124.1	3.59
Hollow	No grout	Full	30.0	530.0	110.1	48.0	606.3	126.0	3.55
100% solid/solidly grouted		Full	115.5	891.7	185.3	115.5	891.7	185.3	2.78
Hollow	16	Face shell	72.8	710.8	147.7	89.1	778.3	161.7	2.96
Hollow	24	Face shell	58.5	650.5	135.2	74.8	718.0	149.2	3.10
Hollow	32	Face shell	51.4	620.4	128.9	67.7	687.9	142.9	3.19
Hollow	40	Face shell	47.1	602.3	125.2	63.4	669.8	139.2	3.25
Hollow	48	Face shell	44.3	590.2	122.6	60.6	657.7	136.7	3.29
Hollow	96	Face shell	37.1	560.1	116.4	53.5	627.6	130.4	3.43
Hollow	120	Face shell	35.7	554.1	115.1	52.0	621.6	129.2	3.46

FOOTNOTES:

^A Net cross-sectional properties determined from a vertical plane that coincides with the face shells of the units. Net cross-sectional properties are to be used for determining stress and strain resulting from the application of load.

^B Average cross-sectional properties determined from two vertical planes calculated as the average of the net and solid properties. Average cross-sectional properties are to be used for determining stiffness and deflection of an element.

^C Because of the small core size and resulting difficulty consolidating grout, 4-in. (102-mm) units are rarely grouted.

Table 5—12-inch (305-mm) Single Wythe Walls, 1¼ in. (32 mm) Face Shells (standard)

5a: Horizontal Section Properties (Masonry Spanning Vertically)									
Unit	Grout spacing (in.)	Mortar bedding	Net cross-sectional properties ^A			Average cross-sectional properties ^B			
			A_n (in. ² /ft)	I_n (in. ⁴ /ft)	S_n (in. ³ /ft)	A_{avg} (in. ² /ft)	I_{avg} (in. ⁴ /ft)	S_{avg} (in. ³ /ft)	r_{avg} (in.)
Hollow	No grout	Face shell	30.0	811.2	139.6	53.1	971.5	167.1	4.28
Hollow	No grout	Full	53.1	971.5	167.1	53.1	971.5	167.1	4.28
100% solid/solidly grouted		Full	139.5	1,571.0	270.3	139.5	1,571.0	270.3	3.36
Hollow	16	Face shell	87.3	1,208.9	208.0	95.0	1,262.3	217.2	3.64
Hollow	24	Face shell	68.2	1,076.3	185.2	81.0	1,165.4	200.5	3.79
Hollow	32	Face shell	58.7	1,010.1	173.8	74.1	1,116.9	192.2	3.88
Hollow	40	Face shell	52.9	970.3	166.9	69.9	1,087.8	187.2	3.95
Hollow	48	Face shell	49.1	943.8	162.4	67.1	1,068.4	183.8	3.99
Hollow	72	Face shell	42.7	899.6	154.8	62.4	1,036.1	178.3	4.07
Hollow	96	Face shell	39.6	877.5	151.0	60.1	1,020.0	175.5	4.12
Hollow	120	Face shell	37.6	864.2	148.7	58.7	1,010.3	173.8	4.15

5b: Vertical Section Properties (Masonry Spanning Horizontally)									
Hollow	No grout	Face shell	30.0	811.2	139.6	50.9	955.9	164.5	4.33
Hollow	No grout	Full	30.0	811.2	139.6	53.1	971.5	167.1	4.28
100% solid/solidly grouted		Full	139.5	1,571.0	270.3	139.5	1,571.0	270.3	3.36
Hollow	16	Face shell	84.8	1,191.1	204.9	105.7	1,335.8	229.8	3.56
Hollow	24	Face shell	66.5	1,064.5	183.1	87.4	1,209.2	208.0	3.72
Hollow	32	Face shell	57.4	1,001.2	172.2	78.3	1,145.9	197.1	3.83
Hollow	40	Face shell	51.9	963.2	165.7	72.8	1,107.9	190.6	3.90
Hollow	48	Face shell	48.3	937.8	161.3	69.2	1,082.6	186.3	3.96
Hollow	96	Face shell	39.1	874.5	150.5	60.1	1,019.3	175.4	4.12
Hollow	120	Face shell	37.3	861.9	148.3	58.2	1,006.6	173.2	4.16

Table 6—14-inch (356-mm) Single Wythe Walls, 1¼ in. (32 mm) Face Shells (standard)

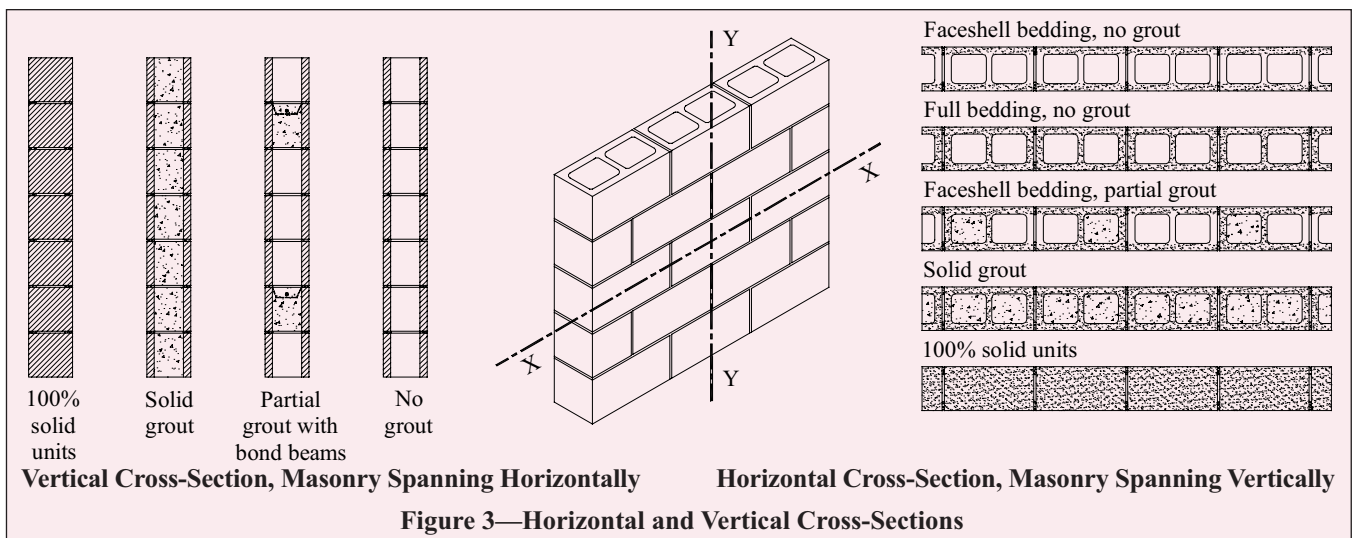
6a: Horizontal Section Properties (Masonry Spanning Vertically)									
Unit	Grout spacing (in.)	Mortar bedding	Net cross-sectional properties ^A			Average cross-sectional properties ^B			
			A_n (in. ² /ft)	I_n (in. ⁴ /ft)	S_n (in. ³ /ft)	A_{avg} (in. ² /ft)	I_{avg} (in. ⁴ /ft)	S_{avg} (in. ³ /ft)	r_{avg} (in.)
Hollow	No grout	Face shell	30.0	1,152.5	169.2	58.2	1,442.9	211.8	4.98
Hollow	No grout	Full	58.2	1,442.9	211.8	58.2	1,442.9	211.8	4.98
100% solid/solidly grouted		Full	163.5	2,529.4	371.3	163.5	2,529.4	371.3	3.93
Hollow	16	Face shell	99.9	1,873.2	275.0	109.3	1,970.0	289.2	4.25
Hollow	24	Face shell	76.6	1,632.9	239.7	92.2	1,794.3	263.4	4.41
Hollow	32	Face shell	64.9	1,512.8	222.1	83.7	1,706.4	250.5	4.51
Hollow	40	Face shell	58.0	1,440.7	211.5	78.6	1,653.7	242.8	4.59
Hollow	48	Face shell	53.3	1,392.7	204.4	75.2	1,618.6	237.6	4.64
Hollow	72	Face shell	45.5	1,312.6	192.7	69.5	1,560.0	229.0	4.74
Hollow	96	Face shell	41.6	1,272.6	186.8	66.7	1,530.7	224.7	4.79
Hollow	120	Face shell	39.3	1,248.6	183.3	65.0	1,513.2	222.1	4.83

6b: Vertical Section Properties (Masonry Spanning Horizontally)									
Hollow	No grout	Face shell	30.0	1,152.5	169.2	55.5	1,417.9	208.1	5.05
Hollow	No grout	Full	30.0	1,152.5	169.2	58.2	1,442.9	211.8	4.98
100% solid/solidly grouted		Full	163.5	2,529.4	371.3	163.5	2,529.4	371.3	3.93
Hollow	16	Face shell	96.8	1,840.9	270.2	122.3	2,106.3	309.2	4.15
Hollow	24	Face shell	74.5	1,611.4	236.5	100.0	1,876.9	275.5	4.33
Hollow	32	Face shell	63.4	1,496.7	219.7	88.9	1,762.1	258.7	4.45
Hollow	40	Face shell	56.7	1,427.8	209.6	82.2	1,693.3	248.6	4.54
Hollow	48	Face shell	52.3	1,381.9	202.9	77.8	1,647.4	241.8	4.60
Hollow	96	Face shell	41.1	1,267.2	186.0	66.6	1,532.6	225.0	4.80
Hollow	120	Face shell	38.9	1,244.3	182.6	64.4	1,509.7	221.6	4.84

Table 7—16-inch (406-mm) Single Wythe Walls, 1/4 in. (32 mm) Face Shells (standard)

7a: Horizontal Section Properties (Masonry Spanning Vertically)									
Unit	Grout spacing (in.)	Mortar bedding	Net cross-sectional properties ^A			Average cross-sectional properties ^B			
			A_n (in. ² /ft)	I_n (in. ⁴ /ft)	S_n (in. ³ /ft)	A_{avg} (in. ² /ft)	I_{avg} (in. ⁴ /ft)	S_{avg} (in. ³ /ft)	r_{avg} (in.)
Hollow	No grout	Face shell	30.0	1,553.7	198.9	63.2	2,030.6	259.9	5.67
Hollow	No grout	Full	63.2	2,030.6	259.9	63.2	2,030.6	259.9	5.67
100% solid/solidly grouted		Full	187.5	3,814.7	488.3	187.5	3,814.7	488.3	4.51
Hollow	16	Face shell	112.4	2,737.2	350.4	123.5	2,896.2	370.7	4.84
Hollow	24	Face shell	85.0	2,342.7	299.9	103.4	2,607.7	333.8	5.02
Hollow	32	Face shell	71.2	2,145.5	274.6	93.4	2,463.4	315.3	5.14
Hollow	40	Face shell	63.0	2,027.1	259.5	87.3	2,376.9	304.2	5.22
Hollow	48	Face shell	57.5	1,948.2	249.4	83.3	2,319.1	296.9	5.28
Hollow	72	Face shell	48.3	1,816.7	232.5	76.6	2,223.0	284.5	5.39
Hollow	96	Face shell	43.7	1,751.0	224.1	73.3	2,174.9	278.4	5.45
Hollow	120	Face shell	41.0	1,711.5	219.1	71.3	2,146.0	274.7	5.49

7b: Vertical Section Properties (Masonry Spanning Horizontally)									
Hollow	No grout	Face shell	30.0	1,553.7	198.9	60.1	1,992.9	255.1	5.76
Hollow	No grout	Full	30.0	1,553.7	198.9	63.2	2,030.6	259.9	5.67
100% solid/solidly grouted		Full	187.5	3,814.7	488.3	187.5	3,814.7	488.3	4.51
Hollow	16	Face shell	108.8	2,684.2	343.6	138.9	3,123.4	399.8	4.74
Hollow	24	Face shell	82.5	2,307.4	295.3	112.6	2,746.6	351.6	4.94
Hollow	32	Face shell	69.4	2,119.0	271.2	99.5	2,558.2	327.4	5.07
Hollow	40	Face shell	61.5	2,005.9	256.8	91.6	2,445.1	313.0	5.17
Hollow	48	Face shell	56.3	1,930.5	247.1	86.4	2,369.8	303.3	5.24
Hollow	96	Face shell	43.1	1,742.1	223.0	73.2	2,181.3	279.2	5.46
Hollow	120	Face shell	40.5	1,704.4	218.2	70.6	2,143.7	274.4	5.51



NOTATION:

- A_{avg} = average cross-sectional area of masonry, in.² (mm²).
- A_n = net cross-sectional area of masonry, in.² (mm²).
- I_{avg} = moment of inertia of average cross-sectional area of masonry, in.⁴ (mm⁴).
- I_n = moment of inertia of net cross-sectional area of masonry, in.⁴ (mm⁴).
- r_{avg} = radius of gyration of the average cross-sectional area of masonry, in. (mm).
- S_{avg} = section modulus of the average cross-sectional area of masonry, in.³ (mm³).
- S_n = section modulus of the net cross-sectional area of masonry, in.³ (mm³).

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2. *Strength Design of Concrete Masonry*, TEK 14-4A. National Concrete Masonry Association, 2002.
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4. *Standard Specification for Loadbearing Concrete Masonry Units*, ASTM C 90-06. ASTM International, 2006.
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Table 8—8-inch (203-mm) Single Wythe Walls, 2 in. (51 mm) Face Shells (nonstandard)

8a: Horizontal Section Properties (Masonry Spanning Vertically)									
Unit	Grout spacing (in.)	Mortar bedding	Net cross-sectional properties ^A			Average cross-sectional properties ^B			
			A_n (in. ² /ft)	I_n (in. ⁴ /ft)	S_n (in. ³ /ft)	A_{avg} (in. ² /ft)	I_{avg} (in. ⁴ /ft)	S_{avg} (in. ³ /ft)	r_{avg} (in.)
Hollow	No grout	Face shell	48.0	395.7	103.8	56.2	404.6	106.1	2.68
Hollow	No grout	Full	56.2	404.6	106.1	56.2	404.6	106.1	2.68
100% solid/solidly grouted		Full	91.5	443.3	116.3	91.5	443.3	116.3	2.20
Hollow	16	Face shell	70.6	420.4	110.3	73.3	423.4	111.1	2.40
Hollow	24	Face shell	63.1	412.2	108.1	67.6	417.1	109.4	2.48
Hollow	32	Face shell	59.3	408.1	107.0	64.7	414.0	108.6	2.53
Hollow	40	Face shell	57.0	405.6	106.4	63.0	412.1	108.1	2.56
Hollow	48	Face shell	55.5	403.9	106.0	61.9	410.9	107.8	2.58
Hollow	72	Face shell	53.0	401.2	105.2	60.0	408.8	107.2	2.61
Hollow	96	Face shell	51.8	399.8	104.9	59.0	407.8	107.0	2.63
Hollow	120	Face shell	51.0	399.0	104.7	58.4	407.1	106.8	2.64
8b: Vertical Section Properties (Masonry Spanning Horizontally)									
Hollow	No grout	Face shell	48.0	395.7	103.8	55.4	400.7	105.1	2.69
Hollow	No grout	Full	48.0	395.7	103.8	56.2	404.6	106.1	2.68
100% solid/solidly grouted		Full	91.5	443.3	116.3	91.5	443.3	116.3	2.20
Hollow	16	Face shell	69.8	419.5	110.0	77.1	424.5	111.4	2.35
Hollow	24	Face shell	62.5	411.6	108.0	69.9	416.6	109.3	2.44
Hollow	32	Face shell	58.9	407.6	106.9	66.3	412.6	108.2	2.50
Hollow	40	Face shell	56.7	405.2	106.3	64.1	410.2	107.6	2.53
Hollow	48	Face shell	55.3	403.6	105.9	62.6	408.7	107.2	2.55
Hollow	96	Face shell	51.6	399.7	104.8	59.0	404.7	106.1	2.62
Hollow	120	Face shell	50.9	398.9	104.6	58.3	403.9	105.9	2.63

Table 9—8-inch (203-mm) Single Wythe Walls, 1³/₈ in. (35 mm) Face Shells (nonstandard)

9a: Horizontal Section Properties (Masonry Spanning Vertically)									
Unit	Grout spacing (in.)	Mortar bedding	Net cross-sectional properties ^A			Average cross-sectional properties ^B			
			A_n (in. ² /ft)	I_n (in. ⁴ /ft)	S_n (in. ³ /ft)	A_{avg} (in. ² /ft)	I_{avg} (in. ⁴ /ft)	S_{avg} (in. ³ /ft)	r_{avg} (in.)
Hollow	No grout	Face shell	33.0	327.5	85.9	44.0	349.2	91.6	2.82
Hollow	No grout	Full	44.0	349.2	91.6	44.0	349.2	91.6	2.82
100% solid/solidly grouted		Full	91.5	443.3	116.3	91.5	443.3	116.3	2.20
Hollow	16	Face shell	63.4	387.7	101.7	67.0	394.9	103.6	2.43
Hollow	24	Face shell	53.3	367.6	96.4	59.4	379.7	99.6	2.53
Hollow	32	Face shell	48.2	357.6	93.8	55.5	372.0	97.6	2.59
Hollow	40	Face shell	45.2	351.5	92.2	53.2	367.5	96.4	2.63
Hollow	48	Face shell	43.1	347.5	91.2	51.7	364.4	95.6	2.66
Hollow	72	Face shell	39.8	340.8	89.4	49.1	359.3	94.3	2.71
Hollow	96	Face shell	38.1	337.5	88.5	47.8	356.8	93.6	2.73
Hollow	120	Face shell	37.1	335.5	88.0	47.0	355.3	93.2	2.75
9b: Vertical Section Properties (Masonry Spanning Horizontally)									
Hollow	No grout	Face shell	33.0	327.5	85.9	42.9	345.3	90.6	2.84
Hollow	No grout	Full	33.0	327.5	85.9	44.0	349.2	91.6	2.82
100% solid/solidly grouted		Full	91.5	443.3	116.3	91.5	443.3	116.3	2.20
Hollow	16	Face shell	62.3	385.4	101.1	72.2	403.2	105.8	2.36
Hollow	24	Face shell	52.5	366.1	96.0	62.4	383.9	100.7	2.48
Hollow	32	Face shell	47.6	356.4	93.5	57.6	374.3	98.2	2.55
Hollow	40	Face shell	44.7	350.6	92.0	54.6	368.5	96.6	2.60
Hollow	48	Face shell	42.8	346.8	91.0	52.7	364.6	95.6	2.63
Hollow	96	Face shell	37.9	337.1	88.4	47.8	354.9	93.1	2.72
Hollow	120	Face shell	36.9	335.2	87.9	46.8	353.0	92.6	2.75

Table 10—10-inch (254-mm) Single Wythe Walls, 1³/₈ in. (35 mm) Face Shells (nonstandard)

10a: Horizontal Section Properties (Masonry Spanning Vertically)									
Unit	Grout spacing (in.)	Mortar bedding	Net cross-sectional properties ^A			Average cross-sectional properties ^B			
			A_n (in. ² /ft)	I_n (in. ⁴ /ft)	S_n (in. ³ /ft)	A_{avg} (in. ² /ft)	I_{avg} (in. ⁴ /ft)	S_{avg} (in. ³ /ft)	r_{avg} (in.)
Hollow	No grout	Face shell	33.0	566.7	117.8	50.4	635.3	132.0	3.55
Hollow	No grout	Full	50.4	635.3	132.0	50.4	635.3	132.0	3.55
100% solid/solidly grouted		Full	115.5	891.7	185.3	115.5	891.7	185.3	2.78
Hollow	16	Face shell	76.2	736.8	153.1	82.0	759.7	157.9	3.04
Hollow	24	Face shell	61.8	680.1	141.3	71.5	718.2	149.2	3.17
Hollow	32	Face shell	54.6	651.8	135.4	66.2	697.5	144.9	3.25
Hollow	40	Face shell	50.3	634.8	131.9	63.0	685.0	142.3	3.30
Hollow	48	Face shell	47.4	623.4	129.5	60.9	676.7	140.6	3.33
Hollow	72	Face shell	42.6	604.5	125.6	57.4	662.9	137.7	3.40
Hollow	96	Face shell	40.2	595.1	123.6	55.7	656.0	136.3	3.43
Hollow	120	Face shell	38.8	589.4	122.5	54.6	651.8	135.4	3.45
10b: Vertical Section Properties (Masonry Spanning Horizontally)									
Hollow	No grout	Face shell	33.0	566.7	117.8	48.8	626.4	130.2	3.58
Hollow	No grout	Full	33.0	566.7	117.8	50.4	635.3	132.0	3.55
100% solid/solidly grouted		Full	115.5	891.7	185.3	115.5	891.7	185.3	2.78
Hollow	16	Face shell	74.3	729.2	151.5	90.0	788.9	163.9	2.96
Hollow	24	Face shell	60.5	675.0	140.3	76.3	734.8	152.7	3.10
Hollow	32	Face shell	53.6	648.0	134.6	69.4	707.7	147.1	3.19
Hollow	40	Face shell	49.5	631.7	131.3	65.3	691.4	143.7	3.25
Hollow	48	Face shell	46.8	620.9	129.0	62.5	680.6	141.4	3.30
Hollow	96	Face shell	39.9	593.8	123.4	55.6	653.5	135.8	3.43
Hollow	120	Face shell	38.5	588.4	122.3	54.3	648.1	134.7	3.46

Table 11—12-inch (305-mm) Single Wythe Walls, 1¹/₂ in. (38 mm) Face Shells (nonstandard)

11a: Horizontal Section Properties (Masonry Spanning Vertically)									
Unit	Grout spacing (in.)	Mortar bedding	Net cross-sectional properties ^A			Average cross-sectional properties ^B			
			A_n (in. ² /ft)	I_n (in. ⁴ /ft)	S_n (in. ³ /ft)	A_{avg} (in. ² /ft)	I_{avg} (in. ⁴ /ft)	S_{avg} (in. ³ /ft)	r_{avg} (in.)
Hollow	No grout	Face shell	36.0	929.4	159.9	57.8	1,064.7	183.2	4.29
Hollow	No grout	Full	57.8	1,064.7	183.2	57.8	1,064.7	183.2	4.29
100% solid/solidly grouted		Full	139.5	1,571.0	270.3	139.5	1,571.0	270.3	3.36
Hollow	16	Face shell	90.2	1,265.2	217.7	97.5	1,310.4	225.4	3.67
Hollow	24	Face shell	72.1	1,153.3	198.4	84.2	1,228.5	211.4	3.82
Hollow	32	Face shell	63.1	1,097.3	188.8	77.6	1,187.5	204.3	3.91
Hollow	40	Face shell	57.7	1,063.7	183.0	73.7	1,163.0	200.1	3.97
Hollow	48	Face shell	54.1	1,041.3	179.2	71.0	1,146.6	197.3	4.02
Hollow	72	Face shell	48.0	1,004.0	172.7	66.6	1,119.3	192.6	4.10
Hollow	96	Face shell	45.0	985.4	169.5	64.4	1,105.7	190.2	4.14
Hollow	120	Face shell	43.2	974.2	167.6	63.1	1,097.5	188.8	4.17
11b: Vertical Section Properties (Masonry Spanning Horizontally)									
Hollow	No grout	Face shell	36.0	929.4	159.9	55.8	1,049.2	180.5	4.34
Hollow	No grout	Full	36.0	929.4	159.9	57.8	1,064.7	183.2	4.29
100% solid/solidly grouted		Full	139.5	1,571.0	270.3	139.5	1,571.0	270.3	3.36
Hollow	16	Face shell	87.8	1,250.2	215.1	107.5	1,370.0	235.7	3.57
Hollow	24	Face shell	70.5	1,143.3	196.7	90.3	1,263.1	217.3	3.74
Hollow	32	Face shell	61.9	1,089.8	187.5	81.7	1,209.6	208.1	3.85
Hollow	40	Face shell	56.7	1,057.7	182.0	76.5	1,177.5	202.6	3.92
Hollow	48	Face shell	53.3	1,036.3	178.3	73.0	1,156.1	198.9	3.98
Hollow	96	Face shell	44.6	982.9	169.1	64.4	1,102.7	189.7	4.14
Hollow	120	Face shell	42.9	972.2	167.3	62.7	1,092.0	187.9	4.17

Table 12—14-inch (356-mm) Single Wythe Walls, 1½ in. (38 mm) Face Shells (nonstandard)

12a: Horizontal Section Properties (Masonry Spanning Vertically)									
Unit	Grout spacing (in.)	Mortar bedding	Net cross-sectional properties ^A			Average cross-sectional properties ^B			
			A_n (in. ² /ft)	I_n (in. ⁴ /ft)	S_n (in. ³ /ft)	A_{avg} (in. ² /ft)	I_{avg} (in. ⁴ /ft)	S_{avg} (in. ³ /ft)	r_{avg} (in.)
Hollow	No grout	Face shell	36.0	1,329.9	195.2	62.9	1,582.9	232.4	5.02
Hollow	No grout	Full	62.9	1,582.9	232.4	62.9	1,582.9	232.4	5.02
100% solid/solidly grouted		Full	163.5	2,529.4	371.3	163.5	2,529.4	371.3	3.93
Hollow	16	Face shell	102.7	1,957.7	287.4	111.7	2,042.1	299.8	4.28
Hollow	24	Face shell	80.5	1,748.5	256.7	95.4	1,889.0	277.3	4.45
Hollow	32	Face shell	69.4	1,643.8	241.3	87.3	1,812.5	266.1	4.56
Hollow	40	Face shell	62.7	1,581.0	232.1	82.4	1,766.6	259.3	4.63
Hollow	48	Face shell	58.2	1,539.2	225.9	79.2	1,736.0	254.8	4.68
Hollow	72	Face shell	50.8	1,469.4	215.7	73.7	1,684.9	247.3	4.78
Hollow	96	Face shell	47.1	1,434.5	210.6	71.0	1,659.4	243.6	4.83
Hollow	120	Face shell	44.9	1,413.6	207.5	69.4	1,644.1	241.3	4.87
12b: Vertical Section Properties (Masonry Spanning Horizontally)									
Hollow	No grout	Face shell	36.0	1,329.9	195.2	60.4	1,557.9	228.7	5.08
Hollow	No grout	Full	36.0	1,329.9	195.2	62.9	1,582.9	232.4	5.02
100% solid/solidly grouted		Full	163.5	2,529.4	371.3	163.5	2,529.4	371.3	3.93
Hollow	16	Face shell	99.8	1,929.6	283.2	124.1	2,157.6	316.7	4.17
Hollow	24	Face shell	78.5	1,729.7	253.9	102.9	1,957.7	287.4	4.36
Hollow	32	Face shell	67.9	1,629.8	239.2	92.2	1,857.8	272.7	4.49
Hollow	40	Face shell	61.5	1,569.8	230.4	85.9	1,797.8	263.9	4.58
Hollow	48	Face shell	57.3	1,529.8	224.6	81.6	1,757.8	258.0	4.64
Hollow	96	Face shell	46.6	1,429.8	209.9	71.0	1,657.8	243.4	4.83
Hollow	120	Face shell	44.5	1,409.9	207.0	68.9	1,637.9	240.4	4.88

Table 13—16-inch (406-mm) Single Wythe Walls, 1½ in. (38 mm) Face Shells (nonstandard)

13a: Horizontal Section Properties (Masonry Spanning Vertically)									
Unit	Grout spacing (in.)	Mortar bedding	Net cross-sectional properties ^A			Average cross-sectional properties ^B			
			A_n (in. ² /ft)	I_n (in. ⁴ /ft)	S_n (in. ³ /ft)	A_{avg} (in. ² /ft)	I_{avg} (in. ⁴ /ft)	S_{avg} (in. ³ /ft)	r_{avg} (in.)
Hollow	No grout	Face shell	36.0	1,802.4	230.7	68.0	2,226.9	285.0	5.72
Hollow	No grout	Full	68.0	2,226.9	285.0	68.0	2,226.9	285.0	5.72
100% solid/solidly grouted		Full	187.5	3,814.7	488.3	187.5	3,814.7	488.3	4.51
Hollow	16	Face shell	115.3	2,855.7	365.5	126.0	2,997.2	383.6	4.88
Hollow	24	Face shell	88.9	2,504.6	320.6	106.6	2,740.4	350.8	5.07
Hollow	32	Face shell	75.7	2,329.0	298.1	97.0	2,612.0	334.3	5.19
Hollow	40	Face shell	67.7	2,223.7	284.6	91.2	2,535.0	324.5	5.27
Hollow	48	Face shell	62.4	2,153.5	275.6	87.3	2,483.6	317.9	5.33
Hollow	72	Face shell	53.6	2,036.5	260.7	80.8	2,398.0	307.0	5.45
Hollow	96	Face shell	49.2	1,977.9	253.2	77.6	2,355.3	301.5	5.51
Hollow	120	Face shell	46.6	1,942.8	248.7	75.7	2,329.6	298.2	5.55
13b: Vertical Section Properties (Masonry Spanning Horizontally)									
Hollow	No grout	Face shell	36.0	1,802.4	230.7	65.0	2,189.1	280.2	5.81
Hollow	No grout	Full	36.0	1,802.4	230.7	68.0	2,226.9	285.0	5.72
100% solid/solidly grouted		Full	187.5	3,814.7	488.3	187.5	3,814.7	488.3	4.51
Hollow	16	Face shell	111.8	2,808.5	359.5	140.7	3,195.3	409.0	4.77
Hollow	24	Face shell	86.5	2,473.2	316.6	115.5	2,859.9	366.1	4.98
Hollow	32	Face shell	73.9	2,305.5	295.1	102.8	2,692.2	344.6	5.12
Hollow	40	Face shell	66.3	2,204.9	282.2	95.3	2,591.6	331.7	5.22
Hollow	48	Face shell	61.0	2,137.8	273.6	90.2	2,524.5	323.1	5.29
Hollow	96	Face shell	48.0	1,970.1	252.2	77.6	2,356.8	301.7	5.51
Hollow	120	Face shell	46.1	1,936.5	247.9	75.1	2,323.3	297.4	5.56

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