TECH NOTE TEK 17-01D

Provided By:



ASD OF CONCRETE MASONRY LINTELS BASED ON THE 2012 IBC/2011 MSJC

INTRODUCTION

Lintels and beams are horizontal structural members designed to carry loads above openings. Although lintels may be constructed of grouted and reinforced concrete masonry units, precast or cast-in-place concrete, or structural steel, this TEK addresses reinforced concrete masonry lintels only. Concrete masonry lintels have the advantages of easily maintaining the bond pattern, color, and surface texture of the surrounding masonry and being placed without need for special lifting equipment.

Concrete masonry lintels are sometimes constructed as a portion of a continuous bond beam. This construction provides several benefits: it is considered to be more advantageous in high seismic areas or areas where high winds may be expected to occur; control of wall movement due to shrinkage or temperature differentials is more easily accomplished; and lintel deflection may be substantially reduced.

The content presented in this TEK is based on the requirements of the 2012 IBC (ref. 1a), which in turn references the 2011 edition of the MSJC Code (ref. 2a).

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. 3), along with a detailed presentation of all of the allowable stress design provisions of the 2012 IBC.

DESIGN LOADS

Vertical loads carried by lintels typically include:

- distributed loads from the dead weight of the lintel, the dead weight of the masonry above, and any floor and roof loads, dead and live loads supported by the masonry; and
- (2) concentrated loads from floor beams, roof joists, or other beams framing into the wall. Axial load carried by lintels is negligible.

Most of these loads can be separated into the four types illustrated in Figure 1: uniform load acting over the effective span; triangular load with apex at mid-span acting over the effective span; concentrated load; and uniform load acting over a portion of the effective span.

The designer calculates the effects of each individual load and then combines them using superposition to determine the overall effect, typically by assuming the lintel is a simply supported beam.

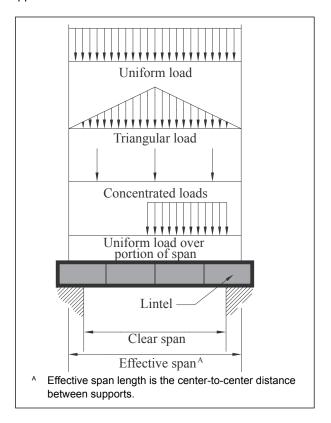


Figure 1—Typical Lintel Load Components

Arching Action

For some configurations, the masonry will distribute applied loads in such a manner that they do not act on the lintel. This is called arching action of masonry. Arching action can be assumed when the following conditions are met (see also Figure 2):

- · masonry wall laid in running bond,
- sufficient wall height above the lintel to permit formation of a symmetrical triangle with base angles of 45° from the horizontal as shown in Figure 2,
- at least 8 in. (203 mm) of wall height above the apex of the 45° triangle.
- minimum end bearing (4 in. (102 mm) typ.) is maintained,
- control joints are not located adjacent to the lintel, and
- sufficient masonry on each side of the opening to resist lateral thrust from the arching action.

Lintel Loading

The loads supported by a lintel depend on whether or not arching action can occur. When arching is not present, the lintel self-weight, the full weight of the wall section above the lintel and superimposed loads are considered. Self weight is a uniform load based on lintel weight (see Table 1).

When arching occurs, the wall weight supported by the lintel is taken as the wall weight within the triangular area below the apex (see Figure 2 and Table 2). This triangular load has a base equal to the effective span length of the lintel and a height of half the effective span. Any superimposed roof and floor live and dead loads outside this triangle are neglected, since they are assumed to be distributed to the masonry on either side of the lintel. Loads applied within the triangle need to be considered, however.

Concentrated loads are assumed to be distributed as illustrated in Figure 3. The load is then resolved onto the lintel as a uniform load, with a magnitude determined by dividing the concentrated load by this length. In most cases, this results in a uniform load acting over a portion of the lintel span.

The MSJC (ref. 2) does not address how to apply uniform loads that are applied within the 45° triangle. There are two schools of thought (see Figure 4):

- Apply the full uniform load directly to the lintel without further distribution just as though there was no arching for those loads.
- 2. Distribute the portions of uniform loads that are applied within the 45° triangle to the lintel. These uniform loads within the 45° triangle may be dispersed and distributed at a 45° angle onto the lintel (ref. 5).

Lintels are required to be designed to have adequate stiffness to limit deflections that would adversely affect strength or serviceability. In addition, the deflection of lintels supporting unreinforced masonry is limited to the clear lintel span divided by 600 to limit damage to the supported masonry (ref. 2).

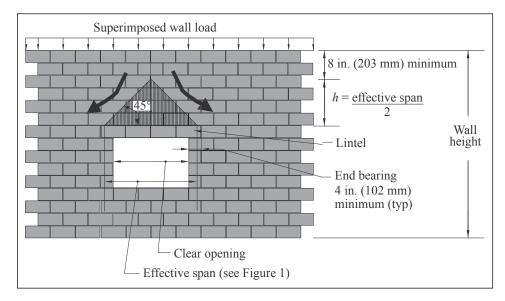


Figure 2—Arching Action

Table 1—Lintel Weights per Foot, Diintel, Ib/ft (kN/m)^A

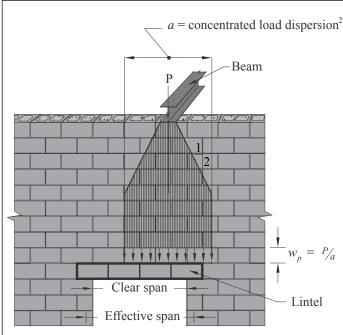
Nominal		Nominal w	all thickness, i	in. (mm)	
lintel height, in. (mm)	6 (152)	8 (203)	10 (254)	12 (305)	16 (406)
		Liç	ghtweight CMU		
8 (203)	38 (0.56)	51 (0.75)	65 (0.95)	80 (1.2)	108 (1.6)
16 (406)	76 (1.1)	103 (1.5)	131 (1.9)	160 (2.3)	216 (3.2)
24 (610)	114 (1.7)	154 (2.3)	196 (2.9)	240 (3.5)	324 (4.8)
		Nor	mal weight CMI	J	
8 (203)	43 (0.63)	58 (0.84)	73 (1.1)	88 (1.3)	118 (1.8)
16 (406)	86 (1.3)	116 (1.7)	145 (2.1)	176 (2.6)	236 (3.5)
24 (610)	128 (1.9)	174 (2.5)	218 (3.2	264 (3.9)	354 (5.2)

A Face shell mortar bedding. Unit weights: grout = 140 pcf (2,242 kg/m³); lightweight masonry units = 100 pcf (1602 kg/m³); normal weight units = 135 pcf (2,162 kg/m³).

Grouted			Wall w	eight, lb/ft²	(kg/m³) for	wall thickr	nesses, in.	(mm), of:		
cell spac- ing, in.		Li	ghtweight	units			Nor	mal weight	units	
(mm) o.c.:	6 (152)	8 (203)	10 (254)	12 (305)	16 (406)	6 (152)	8 (203)	10 (254)	12 (305)	16 (406)
None	23 (112)	29 (142)	34 (166)	37 (181)	44 (215)	30 (147)	39 (191)	45 (220)	49 (239)	58 (283)
48 (1,219)	28 (137)	37 (181)	44 (215)	51 (249)	64 (313)	36 (176)	47 (230)	55 (269)	63 (308)	78 (381)
40 (1,016)	30 (147)	39 (191)	47 (230)	54 (264)	67 (327)	37 (181)	48 (235)	58 (283)	66 (323)	82 (401)
32 (812)	31 (151)	41 (200)	50 (244)	58 (283)	73 (357)	39 (191)	51 (249)	61 (298)	70 (342)	88 (430)
24 (610)	34 (166)	45 (220)	55 (269)	65 (318)	83 (406)	41 (200)	55 (269)	66 (323)	77 (376)	98 (479)
16 (406)	40 (195)	53 (259)	66 (323)	78 (381)	103 (503)	47 (230)	63 (308)	77 (376)	90 (440)	118 (577)
Full grout	57 (279)	77 (376)	98 (479)	120 (587)	163 (796)	64 (313)	86 (420)	109 (533)	132 (645)	177 (865)

Table 2—Wall Weights^{A, B}

- A Assumes face shell mortar bedding. Unit weights: grout = 140 pcf (2,242 kg/m³); lightweight masonry units = 100 pcf (1,602 kg/m³); normal weight units = 135 pcf (2,162 kg/m³).
- B Additional wall weights can be found in TEK 14-13B (ref. 4).



Notes:

- The 2005 MSJC (ref. 2c) provides for the concentrated load to be distributed at a 45° angle rather than at a 1:2 slope as required by the 2008 and 2011 MSJC (refs. 2a and 2b).
- 2) For running bond, the concentrated load dispersion terminates at: half the wall height; a movement joint; the end of the wall; or an opening—whichever provides the smallest length. For other than running bond, the concentrated load is permitted to be distributed through the bond beam but not across head joints below the bond beam.

Figure 3—Distribution of Concentrated Load for Running Bond Construction

DESIGN TABLES

Tables 3 and 4 present allowable shear and moment, respectively, for various concrete masonry lintels, with various amounts of reinforcement and bottom cover based on a specified compressive strength of masonry, $f_m = 1,500$ psi (10.3 MPa) and the allowable stress design provisions of the 2011 MSJC (ref. 2a) and the 2012 IBC (ref.1a).

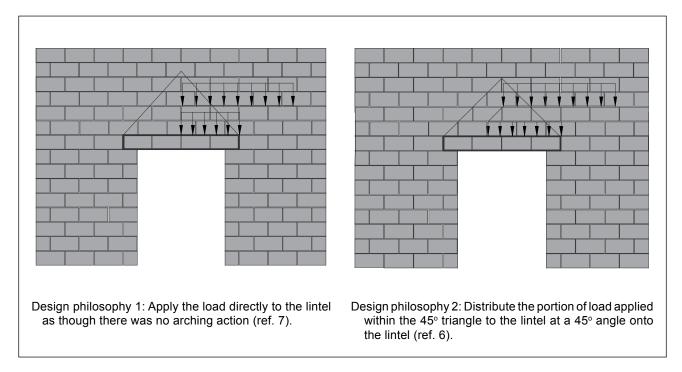


Figure 4—Methods of Applying Uniform Loads that Occur Within the 45° Triangle

Table 3—Allowable Shear Capacities for Concrete Masonry Lintels^A

Lintel size, in. (mm)	Allov	vable shear ^{B, C} , lb (kN	l), for bottom cover, in	ı. (mm):
(width x height):	1.5 (38)	2.0 (51)	2.5 (64)	3.0 (76)
6 x 8 (152 x 203)	919 (4.09)	796 (3.54)	673 (2.99)	551 (2.45)
6 x 16 (152 x 406)	3,369 (14.99)	3,247 (14.44)	3,124 (13.90)	3,002 (13.35)
6 x 24 (152 x 610)	5,330 (23.71)	5,208 (23.17)	5,085 (22.62)	4,963 (22.08)
8 x 8 (203 x 203)	1,910 (8.50)	1,744 (7.76)	1,578 (7.02)	1,411 (6.28)
8 x 16 (203 x 406)	4,568 (20.32)	4,402 (19.58)	4,235 (18.84)	4,069 (18.10)
8 x 24 (203 x 610)	7,225 (32.14)	7,059 (31.40)	6,893 (30.66)	6,727 (29.92)
10 x 8 (254 x 203)	2,411 (10.72)	2,201 (9.79)	1,992 (8.86)	1,782 (7.93)
10 x 16 (254 x 406)	5,766 (25.65)	5,556 (24.71)	5,346 (23.78)	5,137 (22.85)
10 x 24 (254 x 610)	9,121 (40.57)	8,911 (39.64)	8,701 (38.70)	8,492 (37.77)
12 x 8 (305 x 203)	2,912 (12.95)	2,659 (11.83)	2,405 (10.70)	2,152 (9.57)
12 x 16 (305 x 406)	6,964 (30.98)	6,711 (29.85)	6,458 (28.73)	6,204 (27.60)
12 x 24 (305 x 610)	11,016 (49.00)	10,763 (47.88)	10,510 (46.75)	10,256 (45.62)
16 x 8 (406 x 203)	3,914 (17.41)	3,574 (15.90)	3,233 (14.38)	2,893 (12.87)
16 x 16 (406 x 406)	9,360 (41.64)	9,020 (40.12)	8,680 (38.61)	8,339 (37.09)

[^] Assumes no stirrups, i.e., shear resistance of the steel is neglected. $f_m = 1,500$ psi (10.3 MPa).

For M/Vd = 1 and effective shear area = bd, where d is calculated based on a No. 6 (M#19) bar.

 $^{^{\}rm c}$ Based on 2011 MSJC (ref. 2a) and 2012 IBC (ref. 1a) allowable stress design procedure.

Table 4—Allowable Moment, Ib-in. (kN-m), Capacities for Concrete Masonry Lintels (width x height)^{A, C}

Lintel size in	Reinforcement	No of				Bottom cov	Bottom cover in (mm)			
(mm)	size	bars	1.5 (38)	8)	2 (51)	51)	2.5	2.5 (64)	3 (76)	76)
8 x 9	No. 4 (M#13)	1	22,533 ((2.55)	19,398	(2.19)	16,445	(1.86)	13,683	(1.55)
(152×203)	No. 5 (M#16)	1	25,258 ((2.85)	21,638	(2.44)	18,241	(2.06)	15,076	(1.70)
	No. 6 (M#19)	1	27,235 ((3.08)	23,225	(2.62)	19,475	(2.20)	15,997	(1.81)
6 x 16	No. 4 (M#13)	1	80,473 ((60.6)	77,449	(8.75)	74,429	(8.41)	71,411	(8.07)
(152×406)	No. 5 (M#16)	1	108,375 ((12.24)	101,967	(11.52)	95,705	(10.81)	89,592	(10.12)
	No. 6 (M#19)	1	120,999 ((13.67)	113,709	(12.85)	106,591	(12.04)	99,649	(11.26)
6 x 24	No. 4 (M#13)	1	129,190	(14.60)	126,130	(14.25)	123,072	(13.91)	120,016	(13.56)
(152×610)	No. 5 (M#16)	1	196,210	(22.17)	191,521	(21.64)	186,834	(21.11)	182,151	(20.58)
	No. 6 (M#19)	1	259,090	(29.27)	249,360	(28.17)	239,768	(27.09)	230,316	(26.02)
8 x 8	No. 4 (M#13)	1	27,627 ((3.12)	23,829	(2.69)	20,246	(2.29)	16,888	(1.91)
(203×203)	No. 5 (M#16)	1	31,288 ((3.54)	26,863	(3.04)	22,702	(2.56)	18,816	(2.13)
	No. 6 (M#19)	1	34,046 ((3.85)	29,103	(3.29)	24,469	(2.76)	20,159	(2.28)
	No. 4 (M#13)	2^{B}	34,383 ((3.88)	29,519	(3.34)	24,949	(2.82)	20,687	(2.34)
	No. 5 (M#16)	2^{B}	37,992	(4.29)	32,449	(3.67)	27,263	(3.08)	22,448	(2.54)
8 x 16	No. 4 (M#13)	1	81,481 ((9.21)	78,433	(8.86)	75,387	(8.52)	72,345	(8.17)
(203×406)	No. 5 (M#16)	1	123,411 ((13.94)	118,743	(13.42)	114,080	(12.89)	109,164	(12.33)
	No. 6 (M#19)	1	148,153 ((16.74)	139,337	(15.74)	130,723	(14.77)	122,316	(13.82)
	No. 4 (M#13)	2^{B}	145,474 ((16.44)	136,929	(15.47)	128,576	(14.53)	120,420	(13.61)
	No. 5 (M#16)	2^{B}	167,351 ((18.91)	157,298	(17.77)	147,484	(16.66)	137,911	(15.58)
8 x 24	No. 4 (M#13)	_	130,542 ((14.75)	127,463	(14.40)	124,385	(14.05)	121,309	(13.71)
(203×610)	No. 5 (M#16)	1	198,654	(22.44)	193,927	(21.91)	189,202	(21.38)	184,481	(20.84)
	No. 6 (M#19)	1	277,106 ((31.31)	270,459	(30.56)	263,816	(29.81)	257,178	(29.06)
	No. 4 (M#13)	2^{B}	254,466 ((28.75)	248,406	(28.07)	242,350	(27.38)	236,297	(26.70)
	No. 5 (M#16)	2^{B}	357,742 ((40.42)	344,327	(38.90)	331,103	(37.41)	318,071	(35.94)
10×8	No. 4 (M#13)	_	32,155 ((3.63)	27,773	(3.14)	23,634	(2.67)	19,748	(2.23)
(254×203)	No. 5 (M#16)	1	36,683 ((4.14)	31,545	(3.56)	26,706	(3.02)	22,180	(2.51)
	No. 6 (M#19)	1	40,181 ((4.54)	34,406	(3.89)	28,985	(3.27)	23,933	(2.70)
	No. 4 (M#13)	2	40,489 ((4.57)	34,819	(3.93)	29,484	(3.33)	24,498	(2.77)
	No. 5 (M#16)	2	45,131 ((5.10)	38,617	(4.36)	32,511	(3.67)	26,831	(3.03)
10 x 16	No. 4 (M#13)	_	82,183 ((9.29)	79,119	(8.94)	76,057	(8.59)	72,997	(8.25)
(254×406)	No. 5 (M#16)	_	124,671 ((14.09)	119,972	(13.56)	115,278	(13.02)	110,588	(12.49)
	No. 6 (M#19)	_	172,276 ((19.46)	162,114	(18.32)	152,181	(17.19)	142,481	(16.10)
	No. 4 (M#13)	2		(18.06)	153,813	(17.38)	147,800	(16.70)	140,049	(15.82)
	No. 5 (M#16)	2	195,635 ((22.10)	183,997	(20.79)	172,627	(19.50)	161,532	(18.25)

Table 4—Allowable Moment, Ib-in. (kN-m), Capacities for Concrete Masonry Lintels (width x height)^{A, C} (continued)

size burs 1,5 (38) 2 (51) 2.5 (64) 3 (7) No. 4 (M#13) 1 131,476 (14.85) 128.384 (14.51) 152,503 (14.16) 122,204 No. 5 (M#16) 1 200,337 (22.64) 195,605 (22.10) 190,855 (21.56) 186,108 No. 6 (M#19) 1 279,829 (22.64) 273,406 (30.80) 266,444 (30.11) 259,773 No. 6 (M#13) 2 256,873 (29.02) 250,776 (28.33) 244,683 (27.65) 238,534 No. 5 (M#16) 2 256,873 (38.3) 380,383 (42.88) 31,400 (31.22) 238,534 No. 5 (M#16) 1 41,611 (47.0) 35,886 (4.88) 31,40 33,10 22,356 No. 6 (M#19) 1 45,809 (5.18) 39,279 (4.44) 33,140 (37.4) 27,411 No. 6 (M#19) 1 125,624 (14.19) 120,902 (13.66) 136,548 (3.80) 28,904 No. 6 (M#19) 1 125,624 (14.19) 120,902 (13.66) 116,144 (13.13) 111,471 No. 6 (M#16) 1 125,624 (14.19) 120,902 (13.66) 13.65 <t< th=""><th>Lintel size, in.</th><th>Reinforcement</th><th>No. of</th><th></th><th></th><th></th><th>Bottom cov</th><th>Bottom cover, in. (mm)</th><th></th><th></th><th></th></t<>	Lintel size, in.	Reinforcement	No. of				Bottom cov	Bottom cover, in. (mm)			
No. 4 (M#13) 1 131,476 (14.85) 128,384 (14.51) 125,293 (14.16) 122,204 No. 6 (M#16) 1 200,357 (22.64) 195,605 (22.10) 190,855 (21.56) 186,108 No. 6 (M#13) 2 20,873 (22.64) 26,454 (30.11) 226,837 (22.64) 26,454 (30.11) 238,773 (20.02) No. 4 (M#13) 2 25,873 (29.02) 26,0776 (28.33) 244,683 (25.65) 238,574 No. 5 (M#16) 1 41,611 (4.70) 380,384 (4.59) 371,052 (41.92) 361,729 No. 6 (M#19) 1 45,809 (5.18) 39,279 (4.44) 33,140 (3.74) 25,264 No. 6 (M#19) 1 52,624 (14.19) 39,279 (4.44) 33,140 (3.74) 27,411 No. 4 (M#13) 2 51,714 (5.84) 44,813 (3.01) 33,648 (3.80) 28,894 No. 5 (M#16) 1 55,624 (14.19) 120,902 (13.66) 116,184 (13.13) 111,471 No. 6 (M#13) 1 11,4897 (19.76) 168,258 (19.01) 161,274 (18.24) 135,040 No. 6 (M#14) 1 12,174 (14.93) 125,017 (14.58) 125,017 (14.23) 116,174 No. 6 (M#14) 1 12,174 (14.40) 120,002 (13.66)	(mm)	size	bars	1.5	(38)	2 (.	51)	2.5	(64)	3 ((92
No. 5 (M#16)	10 x 24	No. 4 (M#13)	1	131,476	(14.85)	128,384	(14.51)	125,293	(14.16)	122,204	(13.81)
No. 6 (M#19)	(254×610)	No. 5 (M#16)	П	200,357	(22.64)	195,605	(22.10)	190,855	(21.56)	186,108	(21.03)
No. 4 (N#13) 2 256,873 (29 02) 250,776 (28 33) 244,683 (27 65) 238,594 No. 5 (N#16) 2 389,720 (44 03) 380,883 (42.98) 371,052 (41.22) 36,1729 No. 5 (N#16) 1 41,611 (4.70) 38,026 (4.65) 30,372 (34.3) 22,356 No. 5 (N#16) 1 45,809 (5.18) 39,279 (4.44) 33,140 (3.74) 27,411 No. 5 (N#16) 2 51,714 (5.84) 44,313 (5.01) 37,566 (4.22) 38,994 No. 5 (N#16) 1 125,624 (14.19) 120,902 (13.66) 116,184 (13.13) 111,471 No. 5 (N#16) 1 125,624 (14.19) 120,902 (13.66) 116,184 (13.13) 111,471 No. 6 (N#19) 1 124,897 (19.76) 168,258 (19.01) 161,627 (18.26) 155,004 No. 5 (N#16) 1 122,174 (14.39) 129,072 (14.58) 194,074 (16.84) 132,174 (14.39) No. 5 (N#16) 1 221,425 (25.02) 208,349 (27.24) 195,570 (22.10) 187,330 No. 5 (N#16) 1 221,425 (25.02) 208,349 (27.24) 195,570 (22.10) 187,304 No. 6 (N#19) 1 221,425 (25.02) 208,349 (27.24) 195,570 (22.10) 187,304 No. 6 (N#19) 1 221,425 (25.02) 222,434 (31.9) 228,444 (31.9) 228,426 (42.2) 30,216 (21.70) No. 6 (N#19) 1 228,886 (29.23) 225,563 (22.24) 206,006 (21.70) 187,330 No. 6 (N#19) 1 228,886 (29.23) 225,563 (28.34) 246,442 (27.84) 30,816 No. 6 (N#19) 1 258,949 (6.32) 44,315 (4.53) 34,420 (4.18) 36,816 No. 6 (N#19) 1 258,949 (6.32) 44,435 (6.43) 46,487 (6.53) 34,438 No. 6 (N#19) 1 258,949 (6.32) 44,435 (6.43) 46,487 (6.53) 34,438 No. 6 (N#19) 1 258,940 (6.32) 44,435 (6.43) 46,487 (6.43) 36,946 (1.43) No. 6 (N#19) 1 258,940 (4.43) 36,944 (4.13) 36,946 (4.13) 36		No. 6 (M#19)	1	279,829	(31.62)	273,140	(30.86)	266,454	(30.11)	259,773	(29.35)
No. 5 (M#16) 2 389,720 (44.03) 380,383 (42.98) 371,052 (41.92) 361,729 No. 4 (M#13) 1 33,873 (3.83) 30,883 (3.49) 26,719 (3.02) 22,356 No. 6 (M#19) 1 45,809 (5.18) 39,279 (4.44) 331,440 (3.74) 27,411 No. 6 (M#19) 1 45,809 (5.18) 39,680 (4.48) 33,648 (3.80) 28,004 No. 6 (M#13) 1 25,624 (14.19) 120,902 (13.66) 116,184 (13.13) 111,471 No. 5 (M#16) 1 174,877 (18.21) 120,902 (13.66) 116,184 (13.13) 111,471 No. 5 (M#16) 1 174,877 (14.19) 120,902 (13.66) 116,184 (13.13) 111,471 No. 5 (M#16) 1 174,877 (14.19) 155,121 (17.53) 199,074 (16.84) 145,034 No. 5 (M#16) 2 221,425 (25.02) 208,349 (23.54) 195,570 (22.10) 183,095 No. 5 (M#16) 1 221,774 (14.93) 129,072 (14.38) 125,071 (14.23) 122,872 No. 5 (M#16) 2 221,425 (25.02) 208,349 (23.54) 195,570 (22.10) 183,095 No. 5 (M#16) 1 221,774 (14.93) 125,672 (14.38) 125,971 (14.23) 122,872 No. 5 (M#16) 2 228,686 (29.23) 225,563 (28.24) (31.93) 26,482 No. 5 (M#16) 1 25,499 (6.32) 235,563 (28.24) (31.93) 26,482 No. 5 (M#16) 2 236,490 (6.32) 43,512 (4.92) 36,591 (4.18) 30,816 No. 5 (M#16) 2 26,655 (7.19) 43,512 (4.92) 36,614 (1.18) 31,272 (1.18) 31,272 (1.18) 31,272 (1.18) 31,274 (1.18) 3		No. 4 (M#13)	7	256,873	(29.02)	250,776	(28.33)	244,683	(27.65)	238,594	(26.96)
No. 4 (M#13)		No. 5 (M#16)	2	389,720	(44.03)	380,383	(42.98)	371,052	(41.92)	361,729	(40.87)
No. 5 (M#16)	12 x 8	No. 4 (M#13)	1	33,873	(3.83)	30,863	(3.49)	26,719	(3.02)	22,356	(2.53)
No. 6 (M#19) 1 45,809 (5.18) 39,279 (4.44) 33,140 (3.74) 27,411 No. 5 (M#16) 2 46,082 (5.21) 39,680 (4.48) 37,3648 (3.80) 28,004 No. 5 (M#16) 2 51,714 (5.84) 74,313 (5.01) 37,366 (4.22) 30,894 No. 5 (M#16) 1 125,624 (14.19) 120,902 (13.66) 116,184 (13.13) 111,471 No. 5 (M#16) 1 125,624 (14.19) 120,902 (13.66) 116,184 (13.13) 111,471 No. 5 (M#16) 1 122,174 (14.23) 120,072 (14.58) 125,570 (22.10) 183,095 No. 5 (M#16) 1 221,425 (25.02) 208,349 (23.54) 125,570 (22.10) 183,095 No. 5 (M#16) 1 221,744 (14.93) 129,072 (14.58) 125,570 (22.10) 183,095 No. 5 (M#16) 1 221,744 (14.93) 129,072 (14.58) 125,570 (22.10) 183,095 No. 5 (M#16) 2 281,884 (31.85) 275,164 (31.09) 268,447 (30.33) 261,734 No. 5 (M#16) 2 238,686 (29.23) 252,563 (28.54) 246,442 (27.84) 364,827 No. 5 (M#16) 2 238,686 (29.23) 252,563 (28.54) 246,442 (27.84) 364,827 No. 5 (M#16) 2 55,949 (6.32) 43,334 41,159 (4.55) 33,706 No. 5 (M#16) 2 55,949 (6.32) 43,835 (6.17) 46,189 (5.22) 33,706 No. 5 (M#16) 2 63,635 (7.19) 54,645 (6.17) 46,189 (5.22) 117,744 No. 5 (M#16) 1 126,996 (14.35) 122,241 (13.81) 117,491 (13.27) 117,044 No. 5 (M#16) 2 247,094 (27.92) 23,751 (26.86) 22,841 (13.81) 219,098 (13.27) 144,831 No. 5 (M#16) 2 247,094 (27.92) 23,751 (26.86) 22,841 (13.81) 219,098 (13.20) 24,099 (13.20)	(305×203)	No. 5 (M#16)	П	41,611	(4.70)	35,826	(4.05)	30,372	(3.43)	25,264	(2.85)
No. 5 (M#16) 2		No. 6 (M#19)	П	45,809	(5.18)	39,279	(4.44)	33,140	(3.74)	27,411	(3.10)
No. 5 (M#16) 2 51,714 (5.84) 44,313 (5.01) 37,366 (4.22) 30,894 No. 4 (M#13) 1 82,711 (9.35) 79,634 (9.00) 76,560 (8.65) 73,488 No. 5 (M#16) 1 125,624 (14.19) 120,902 (13.66) 116,184 (13.13) 111,471 No. 6 (M#19) 1 174,897 (19.76) 168,258 (19.01) 161,627 (18.26) 115,004 No. 6 (M#18) 2 221,425 (25.02) 208,349 (23.54) 195,570 (22.10) 183,095 No. 5 (W#16) 1 221,425 (25.02) 208,349 (23.54) 192,097 (14.23) 125,872 No. 4 (W#13) 2 221,425 (22.78) 196,866 (29.23) 252,563 (28.54) 246,442 (27.84) 240,325 No. 4 (W#13) 2 228,686 (29.23) 252,563 (28.54) 246,442 (27.84) 240,325 No. 5 (W#16) 1		No. 4 (M#13)	7	46,082	(5.21)	39,680	(4.48)	33,648	(3.80)	28,004	(3.16)
No. 4 (M#13)		No. 5 (M#16)	2	51,714	(5.84)	44,313	(5.01)	37,366	(4.22)	30,894	(3.49)
No. 5 (M#16)	12 x 16	No. 4 (M#13)	1	82,711	(9.35)	79,634	(00.6)	76,560	(8.65)	73,488	(8.30)
No. 6 (M#19) 1 174,897 (19.76) 168,258 (19.01) 161,627 (18.26) 155,004 No. 4 (M#13) 2 161,174 (18.21) 155,121 (17.53) 149,074 (16.84) 143,034 No. 5 (M#16) 2 221,425 (25.02) 208,349 (23.54) 195,570 (22.10) 183,095 No. 6 (M#13) 1 132,174 (14.93) 129,072 (14.58) 125,971 (14.23) 122,872 No. 6 (M#19) 1 201,635 (22.78) 196,865 (22.24) 192,096 (21.70) 187,330 No. 6 (M#19) 1 281,884 (31.85) 275,164 (31.09) 268,447 (30.33) 261,734 No. 6 (M#16) 2 392,972 (44.40) 383,584 (43.34) 374,202 (42.28) 364,827 No. 5 (M#16) 1 50,450 (3.70) 43,512 (4.92) 36,961 (4.18) 30,816 No. 6 (M#19) 1 55,949 (6.32) 48,069 (5.43) 40,647 (4.59) 34,338 No. 6 (M#10) 1 26,450 (1.35) 34,437 (4.59) 34,348 31,349 No. 6 (M#10) 1 126,996 (14.35) 34,415 (6.42) 36,614 (4.28)	(305×406)	No. 5 (M#16)	1	125,624	(14.19)	120,902	(13.66)	116,184	(13.13)	111,471	(12.59)
No. 4 (M#13) 2 161,174 (18.21) 155,121 (17.53) 149,074 (16.84) 143,034 No. 5 (M#16) 2 221,425 (25.02) 208,349 (23.54) 195,570 (22.10) 183,095 No. 4 (M#13) 1 132,174 (14.93) 129,072 (14.58) 125,971 (14.23) 122,872 No. 6 (M#19) 1 281,884 (31.85) 275,164 (31.09) 268,447 (30.33) 261,734 No. 6 (M#19) 1 281,884 (31.85) 275,164 (31.09) 268,447 (30.33) 261,734 No. 4 (M#13) 2 286.66 (29.23) 252,563 (28.54) 246,442 (27.84) 240,325 No. 4 (M#13) 1 34,307 (3.88) 31,272 (3.53) 28,244 (31.9) 25,225 No. 6 (M#19) 1 50,450 (5.70) 48,069 (5.43) 40,647 (4.59) 33,706 No. 6 (M#16) 1 55,949 (6.34) <		No. 6 (M#19)	П	174,897	(19.76)	168,258	(19.01)	161,627	(18.26)	155,004	(17.51)
No. 5 (M#16) 2 221,425 (25.02) 208,349 (23.54) 195,570 (22.10) 183,095 No. 4 (M#13) 1 132,174 (14.93) 129,072 (14.58) 125,971 (14.23) 122,872 No. 6 (M#19) 1 201,635 (22.78) 196,865 (22.24) 192,096 (21.70) 187,330 No. 6 (M#19) 1 281,884 (31.85) 275,164 (31.09) 268,447 (30.33) 261,734 No. 4 (M#13) 2 258,686 (29.23) 252,563 (28.54) 246,442 (27.84) 240,325 No. 5 (M#16) 1 392,972 (44.40) 383,584 (43.34) 374,202 (42.28) 364,827 No. 5 (M#16) 1 30,450 (5.70) 43,512 (4.92) 36,961 (4.18) 30,816 No. 6 (M#19) 1 55,949 (6.32) 48,069 (5.43) 40,647 (4.59) 34,338 No. 6 (M#16) 1 55,949 (6.32)		No. 4 (M#13)	2	161,174	(18.21)	155,121	(17.53)	149,074	(16.84)	143,034	(16.16)
No. 4 (M#13) 1 132,174 (14.93) 129,072 (14.58) 125,971 (14.23) 122,872 No. 5 (M#16) 1 201,635 (22.78) 196,865 (22.24) 192,096 (21.70) 187,330 No. 6 (M#19) 1 281,884 (31.85) 275,164 (31.09) 268,447 (30.33) 261,734 No. 4 (M#13) 2 258,686 (29.23) 252,563 (28.54) 246,442 (27.84) 240,325 No. 5 (M#16) 2 392,972 (44.40) 383,584 (43.34) 374,202 (42.28) 364,827 No. 4 (M#13) 1 34,307 (3.88) 31,272 (3.53) 28,444 (3.19) 25,225 No. 5 (M#16) 1 50,450 (5.70) 43,512 (4.92) 36,961 (4.18) 30,816 No. 6 (M#13) 2 56,145 (6.34) 48,435 (5.43) 40,647 (4.59) 33,706 No. 5 (M#16) 1 126,996 (14.35) 1		No. 5 (M#16)	2	221,425	(25.02)	208,349	(23.54)	195,570	(22.10)	183,095	(20.69)
No. 5 (M#16) 1 201,635 (22.78) 196,865 (22.24) 192,096 (21.70) 187,330 No. 6 (M#19) 1 281,884 (31.85) 275,164 (31.09) 268,447 (30.33) 261,734 No. 4 (M#13) 2 258,686 (29.23) 252,563 (28.54) 246,442 (27.84) 240,325 No. 4 (M#13) 1 392,972 (44.40) 383,584 (43.34) 374,202 (42.28) 364,827 No. 4 (M#13) 1 34,307 (3.88) 31,272 (3.53) 28,244 (3.19) 25,225 No. 6 (M#19) 1 50,450 (5.70) 43,512 (4.92) 36,961 (4.18) 30,816 No. 6 (M#19) 1 55,949 (6.32) 48,069 (5.43) 40,647 (4.59) 33,706 No. 5 (M#16) 2 63,635 (7.19) 54,645 (6.17) 46,189 (5.22) 38,292 No. 5 (M#16) 1 126,996 (14.35) 170,394<	12 x 24	No. 4 (M#13)	_	132,174	(14.93)	129,072	(14.58)	125,971	(14.23)	122,872	(13.88)
No. 6 (M#19) 1 281,884 (31.85) 275,164 (31.09) 268,447 (30.33) 261,734 No. 4 (M#13) 2 258,686 (29.23) 252,563 (28.54) 246,442 (27.84) 240,325 No. 5 (M#16) 1 392,972 (44.40) 383,584 (43.34) 374,202 (42.28) 364,827 No. 4 (M#13) 1 34,307 (3.88) 31,272 (3.53) 28,244 (3.19) 25,225 No. 5 (M#16) 1 50,450 (5.70) 43,512 (4.92) 36,961 (4.18) 30,816 No. 6 (M#19) 1 55,949 (6.32) 48,069 (5.43) 40,647 (4.59) 33,706 No. 4 (M#13) 2 56,145 (6.34) 80,371 (9.08) 77,279 (4.65) 34,338 No. 4 (M#13) 1 126,996 (14.35) 122,241 (13.81) 117,491 (13.27) 112,744 No. 6 (M#19) 1 177,087 (20.01) 170,394<	(305×610)	No. 5 (M#16)	_	201,635	(22.78)	196,865	(22.24)	192,096	(21.70)	187,330	(21.17)
No. 4 (M#13) 2 258,686 (29.23) 252,563 (28.54) 246,442 (27.84) 240,325 No. 5 (M#16) 2 392,972 (44.40) 383,584 (43.34) 374,202 (42.28) 364,827 No. 4 (M#13) 1 34,307 (3.88) 31,272 (3.53) 28,244 (3.19) 25,225 No. 6 (M#19) 1 50,450 (5.70) 43,512 (4.92) 36,961 (4.18) 30,816 No. 6 (M#19) 1 55,949 (6.32) 48,069 (5.43) 40,647 (4.59) 34,338 No. 4 (M#13) 2 63,635 (7.19) 54,645 (6.17) 46,189 (5.22) 38,292 No. 5 (M#16) 1 126,996 (14.35) 122,241 (13.81) 117,491 (13.77) 112,744 No. 6 (M#19) 1 177,087 (20.01) 170,394 (19.25) 163,708 185,09 144,831 No. 5 (M#16) 2 247,094 (27.92) 237,751 </td <td></td> <td>No. 6 (M#19)</td> <td>1</td> <td>281,884</td> <td>(31.85)</td> <td>275,164</td> <td>(31.09)</td> <td>268,447</td> <td>(30.33)</td> <td>261,734</td> <td>(29.57)</td>		No. 6 (M#19)	1	281,884	(31.85)	275,164	(31.09)	268,447	(30.33)	261,734	(29.57)
No. 5 (M#16) 2 392,972 (44.40) 383,584 (43.34) 374,202 (42.28) 364,827 No. 4 (M#13) 1 34,307 (3.88) 31,272 (3.53) 28,244 (3.19) 25,225 No. 5 (M#16) 1 50,450 (5.70) 43,512 (4.92) 36,961 (4.18) 30,816 No. 6 (M#19) 1 55,949 (6.32) 48,069 (5.43) 40,647 (4.59) 33,706 No. 4 (M#13) 2 56,145 (6.34) 48,435 (5.47) 41,159 (4.65) 34,338 No. 4 (M#13) 1 83,464 (9.43) 80,371 (9.08) 77,279 (8.73) 74,190 No. 5 (M#16) 1 126,996 (14.35) 122,241 (13.81) 117,491 (13.27) 112,744 No. 6 (M#19) 1 177,087 (20.01) 170,394 (19.25) 163,708 18.43) 157,014 (17.74) 150,920 177,679 174,831 No. 4 (M#13) <td></td> <td>No. 4 (M#13)</td> <td>7</td> <td>258,686</td> <td>(29.23)</td> <td>252,563</td> <td>(28.54)</td> <td>246,442</td> <td>(27.84)</td> <td>240,325</td> <td>(27.15)</td>		No. 4 (M#13)	7	258,686	(29.23)	252,563	(28.54)	246,442	(27.84)	240,325	(27.15)
No. 4 (M#13) 1 34,307 (3.88) 31,272 (3.53) 28,244 (3.19) 25,225 No. 5 (M#16) 1 50,450 (5.70) 43,512 (4.92) 36,961 (4.18) 25,225 No. 6 (M#19) 1 55,949 (6.32) 48,069 (5.43) 40,647 (4.59) 33,706 No. 4 (M#13) 2 56,145 (6.34) 48,435 (5.47) 41,159 (4.65) 34,338 No. 4 (M#13) 1 83,464 (9.43) 80,371 (9.08) 77,279 (8.73) 74,190 No. 5 (M#16) 1 126,996 (14.35) 122,241 (13.81) 117,491 (13.27) 112,744 No. 6 (M#19) 1 177,087 (20.01) 170,394 (19.25) 163,708 18.50) 157,029 No. 5 (M#16) 2 247,094 (27.92) 237,751 (26.86) 228,419 (25.81) 219,098		No. 5 (M#16)	2	392,972	(44.40)	383,584	(43.34)	374,202	(42.28)	364,827	(41.22)
No. 5 (M#16) 1 50,450 (5.70) 43,512 (4.92) 36,961 (4.18) 30,816 No. 6 (M#19) 1 55,949 (6.32) 48,069 (5.43) 40,647 (4.59) 33,706 No. 4 (M#13) 2 56,145 (6.34) 48,435 (5.47) 41,159 (4.65) 34,338 No. 5 (M#16) 1 83,464 (9.43) 80,371 (9.08) 77,279 (8.73) 74,190 No. 5 (M#16) 1 177,087 (20,01) 170,394 (19.25) 163,708 (18.50) 157,029 No. 4 (M#13) 2 163,114 (18.43) 157,014 (17.74) 150,920 (17.05) 144,831 No. 5 (M#16) 2 247,094 (27.92) 237,751 (26.86) 228,419 (25.81) 219,098	16 x 8	No. 4 (M#13)	-	34,307	(3.88)	31,272	(3.53)	28,244	(3.19)	25,225	(2.85)
No. 6 (M#19) 1 55,949 (6.32) 48,069 (5.43) 40,647 (4.59) 33,706 No. 4 (M#13) 2 56,145 (6.34) 48,435 (5.47) 41,159 (4.65) 34,338 No. 5 (M#16) 2 63,635 (7.19) 54,645 (6.17) 46,189 (5.22) 38,292 No. 4 (M#13) 1 83,464 (9.43) 80,371 (9.08) 77,279 (8.73) 74,190 No. 5 (M#16) 1 126,996 (14.35) 122,241 (13.81) 117,491 (13.27) 112,744 No. 6 (M#19) 1 177,087 (20.01) 170,394 (19.25) 163,708 (18.50) 157,029 No. 4 (M#13) 2 163,114 (18.43) 157,014 (17.74) 150,920 (17.05) 144,831 No. 5 (M#16) 2 247,094 (27.92) 237,751 (26.86) 228,419 (25.81) 219,098	(406×203)	No. 5 (M#16)	1	50,450	(5.70)	43,512	(4.92)	36,961	(4.18)	30,816	(3.48)
No. 4 (M#13) 2 56,145 (6.34) 48,435 (5.47) 41,159 (4.65) 34,338 No. 5 (M#16) 2 63,635 (7.19) 54,645 (6.17) 46,189 (5.22) 38,292 No. 4 (M#13) 1 83,464 (9.43) 80,371 (9.08) 77,279 (8.73) 74,190 No. 5 (M#16) 1 126,996 (14.35) 122,241 (13.81) 117,491 (13.27) 112,744 No. 6 (M#19) 1 177,087 (20.01) 170,394 (19.25) 163,708 (18.50) 157,029 No. 4 (M#13) 2 163,114 (18.43) 157,014 (17.74) 150,920 (17.05) 144,831 No. 5 (M#16) 2 247,094 (27.92) 237,751 (26.86) 228,419 (25.81) 219,098		No. 6 (M#19)	1	55,949	(6.32)	48,069	(5.43)	40,647	(4.59)	33,706	(3.81)
No. 5 (M#16) 2 63,635 (7.19) 54,645 (6.17) 46,189 (5.22) 38,292 No. 4 (M#13) 1 83,464 (9.43) 80,371 (9.08) 77,279 (8.73) 74,190 No. 5 (M#16) 1 126,996 (14.35) 122,241 (13.81) 117,491 (13.27) 112,744 No. 6 (M#19) 1 177,087 (20.01) 170,394 (19.25) 163,708 (18.50) 157,029 No. 4 (M#13) 2 163,114 (18.43) 157,014 (17.74) 150,920 (17.05) 144,831 No. 5 (M#16) 2 247,094 (27.92) 237,751 (26.86) 228,419 (25.81) 219,098		No. 4 (M#13)	7	56,145	(6.34)	48,435	(5.47)	41,159	(4.65)	34,338	(3.88)
No. 4 (M#13) 1 83,464 (9.43) 80,371 (9.08) 77,279 (8.73) 74,190 No. 5 (M#16) 1 126,996 (14.35) 122,241 (13.81) 117,491 (13.27) 112,744 No. 6 (M#19) 1 177,087 (20.01) 170,394 (19.25) 163,708 (18.50) 157,029 No. 4 (M#13) 2 163,114 (18.43) 157,014 (17.74) 150,920 (17.05) 144,831 No. 5 (M#16) 2 247,094 (27.92) 237,751 (26.86) 228,419 (25.81) 219,098		No. 5 (M#16)	2	63,635	(7.19)	54,645	(6.17)	46,189	(5.22)	38,292	(4.33)
No. 5 (M#16) 1 126,996 (14.35) 122,241 (13.81) 117,491 (13.27) 112,744 No. 6 (M#19) 1 177,087 (20.01) 170,394 (19.25) 163,708 (18.50) 157,029 No. 4 (M#13) 2 163,114 (18.43) 157,014 (17.74) 150,920 (17.05) 144,831 No. 5 (M#16) 2 247,094 (27.92) 237,751 (26.86) 228,419 (25.81) 219,098	16 x 16	No. 4 (M#13)	П	83,464	(9.43)	80,371	(80.68)	77,279	(8.73)	74,190	(8.38)
1 177,087 (20.01) 170,394 (19.25) 163,708 (18.50) 157,029 2 163,114 (18.43) 157,014 (17.74) 150,920 (17.05) 144,831 3 247,094 (27.92) 237,751 (26.86) 228,419 (25.81) 219,098	(406×406)	No. 5 (M#16)	-	126,996	(14.35)	122,241	(13.81)	117,491	(13.27)	112,744	(12.74)
2 163,114 (18.43) 157,014 (17.74) 150,920 (17.05) 144,831 2 247,094 (27.92) 237,751 (26.86) 228,419 (25.81) 219,098		No. 6 (M#19)	1	177,087	(20.01)	170,394	(19.25)	163,708	(18.50)	157,029	(17.74)
) 2 247,094 (27.92) 237,751 (26.86) 228,419 (25.81) 219,098		No. 4 (M#13)	7	163,114	(18.43)	157,014	(17.74)	150,920	(17.05)	144,831	(16.36)
		No. 5 (M#16)	2	247,094	(27.92)	237,751	(26.86)	228,419	(25.81)	219,098	(24.75)

Grade 60 reinforcement. $f_m = 1,500$ psi (10.3 MPa). For 8 in. (204 mm) lintels with two bars, low lift grouting is recommended for adjacent jambs to ensure proper grout flow and consolidation. Based on 2011 MSJC (ref. 2a) and 2012 IBC (ref. 1a) allowable stress design procedure.

DESIGN EXAMPLE

Design a lintel for a 12 in. (305 mm) normal weight concrete masonry wall laid in running bond with vertical reinforcement at 48 in. (1.2 m) o.c. The wall configuration is shown in Figure 5.

Case 1—Arching Action

<u>Check for Arching Action</u>. Determine the height of masonry required for arching action. Assuming the lintel has at least 4 in. (102 mm) bearing on each end, the effective span is:

```
L = 5.33 + 0.33 = 5.67 \text{ ft } (1.7 \text{ m}).
```

The height of masonry above the lintel necessary for arching to occur in the wall (from Figure 2) is h + 8 in. (203 mm) = L/2 + 8 in. = 3.5 ft (1.1 m).

Based on an 8-in. (203-mm) high lintel, there is 18.0 - (3.33 + 4.0 + 0.67) = 10.0 ft (3.0 m) of masonry above the lintel. Therefore, arching is assumed and the superimposed uniform load is neglected.

<u>Design Loads</u>. Because arching occurs, only the lintel and wall dead weights are considered. Lintel weight, from Table 1, for 12 in. (305 mm) normal weight concrete masonry units assuming an 8 in. (203 mm) height is D_{lintel} = 88 lb/ft (1.3 kN/m).

For wall weight, only the triangular portion with a height of 3.5 ft (1.1 m) is considered. From Table 2, wall dead load is:

```
D_{wall} = 63 lb/ft<sup>2</sup> (3.5 ft )
= 221 lb/ft (3.2 kN/m) at the apex.
```

Maximum moment and shear are determined using simply supported beam relationships. The lintel dead weight is considered a uniform load, so the moment and shear are,

```
M_{iintel} = D_{iintel} L^2/8
= (88)(5.7)^2/8
= 357 \text{ lb-ft } (0.48 \text{ kN-m})
V_{iintel} = D_{iintel} L/2
= (88)(5.7)/2 = 251 \text{ lb } (1.1 \text{ kN})
```

For triangular wall load, moment and shear are,

```
M_{wall} = D_{wall} L^2/12
= (221)(5.7)^2/12
= 598 lb-ft (0.81 kN-m)
V_{wall} = D_{wall} L/4
= (221)(5.7)/4 = 315 lb (1.4 kN)
```

Because the maximum moments for the two loading conditions occur in the same locations on the lintel (as well as the maximum shears), the moments and shears are superimposed and summed:

```
M_{max} = 357 + 598
= 955 lb-ft = 11,460 lb-in (1.3 kN-m)
V_{max} = 251 + 315
= 566 lb (2.5 kN)
```

<u>Lintel Design</u>. From Tables 3 and 4, a 12 x 8 lintel with one No. 4 (M#13) bar and 3 in. (76 mm) or less bottom cover has adequate strength ($M_{\rm all}$ = 22,356 lb-in. (2.53 kN-m) and $V_{\rm all}$ = 2,152 lb (9.57 kN)). In this example, shear was conservatively computed at the end of the lintel. However, *Building Code Requirements for Masonry Structures* (ref. 2) allows maximum shear to be calculated using a distance d/2 from the face of the support.

Case 2—No Arching Action

Using the same example, recalculate assuming a 2 ft (0.6 m) height from the bottom of the lintel to the top of the wall. For ease of construction, the entire 2 ft (0.6 m) would be grouted solid, producing a 24 in. (610 mm) deep lintel.

Because the height of masonry above the lintel is less than 3.5 ft (1.1 m), arching cannot be assumed, and the superimposed load must be accounted for.

 D_{lintel} = 264 lb/ft (3.9 kN/m), from Table 1. Because the lintel is 24 in. (610 mm) deep, there is no additional dead load due to masonry above the lintel.

```
W_{total} = 264 lb/ft + 1,000 lb/ft

= 1,264 lb/ft (18.4 kN/m)

M_{max} = wL^2/8

= (1,264)(5.7)^2/8 x 12 in./ft

= 61,601 lb-in (7.0 kN-m)

V_{max} = wL/2 = (1,264)(5.7)/2

= 3,602 lb (16.0 kN)
```

From Tables 3 and 4, a 12 x 24 lintel with one No. 4 (M#13) reinforcing bar and 3 in. (76 mm) or less bottom cover is adequate ($M_{\it all}$ = 122,872 lb-in. (13.88 kN-m) and $V_{\it all}$ = 10,256 lb (45.62 kN).

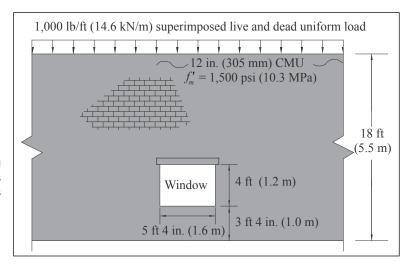


Figure 5—Wall Configuration for Design Example

TEK 17-01D

NOTATIONS

b =width of lintel, in. (mm) $D_{lintel} =$ lintel dead load, lb/ft (kN/m) $D_{wall} =$ wall dead load, lb/ft (kN/m)

 d = distance from extreme compression fiber to centroid of tension reinforcement, in. (mm)

 f'_m = specified compressive strength of masonry, psi (MPa)

h = half of the effective lintel span, L/2, ft (m)

L = effective lintel span, ft (m) M_{all} = allowable moment, in.-lb (N·m) M_{lintel} = maximum moment due to lintel dead load, in.-lb (N·m)

 M_{max} = maximum moment, in.-lb (N·m)

 M_{wall} = maximum moment due to wall dead load moment, in.-lb

(N·m)

 V_{all} = allowable shear, lb (N)

 V_{lintel} = maximum shear due to lintel dead load, lb (N)

 V_{max} = maximum shear, lb (N)

 V_{wall} = maximum shear due to wall dead load, lb (N) W_{total} = total uniform live and dead load, lb/ft (kN/m) w = uniformly distributed load, lb/in. (N/mm)

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ABOUT CMHA

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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