Dimensioning and Estimating Brick Masonry

Abstract: This *Technical Note* presents information for determining the basic layout of brick masonry walls, including both structural and veneer applications. Modular and non-modular brick masonry is discussed, including overall dimensioning of masonry walls using various brick unit sizes. Finally, guidelines are presented to aid the designer in estimating the amount of materials needed for brick masonry.

Key Words: actual dimension, construction, estimating, modular masonry, nominal dimension, size, specified dimension.

SUMMARY OF RECOMMENDATIONS:

Brick and Mortar Joint Sizes:
- Specify brick using standardized nomenclature and specified size (width by height by length)
- For modular brick, specify mortar joint thicknesses such that when added to the specified brick size, the intended modular dimensions result
- When possible, select brick size to minimize cutting

Bond Pattern:
- Select one-half running bond for applications when brick width is one-half of brick length; select one-third running bond when brick width is one-third of brick length

Dimensioning:
- When using modular brick sizes, use multiples of brick dimension plus mortar joint to determine nominal dimensions
- For horizontal dimensions of elements longer than four brick lengths, use nominal dimensions as intended constructed dimensions
- When nominal dimensions are used on plans but are not intended to be used for construction, note plans accordingly

Estimating:
- Use wall area method and tables to determine number of brick and quantity of mortar per wall area
- Modify brick estimates for bond pattern, breakage and waste
- Modify mortar estimates for bond pattern, collar joints and waste
- Include partial brick in estimates to maintain bond at corners
- Determine approximate mortar material quantities based on brick size and bond pattern

INTRODUCTION

Brick are made in a number of sizes and laid in a variety of patterns. Most patterns of brickwork will adhere to a common module that facilitates the dimensioning of the brickwork and any masonry openings. Generally, designers can minimize the number of cuts of whole brick by dimensioning to a module. Knowing the size of the brick and bond pattern will allow an estimate of the number of brick and amount of mortar needed for the project. This *Technical Note* presents information to help the designer to choose a brick size, lay out modular dimensions using the chosen size, and develop a materials estimate for brick and mortar.

Metric Measurements

Throughout this *Technical Note*, dimensions are based on the inch-pound system with conversions given for the metric system. The measurements and dimensions correspond to brick manufactured primarily in the United States to a typical module of 4 in. (102 mm). Brick manufactured for projects requiring metric dimensions typically conform to a module of 100 mm (3.94 in.). Although the principles presented here are the same for either system, care should be used when using the conversions given here for metric modular units and construction.

BRICK SIZES

Brick is a building material with a human scale. Brick sizes have varied over the centuries but have always been similar to present-day sizes. Some sizes were developed to meet specific design, production or construction needs. For example, larger brick were developed to increase bricklaying economy, and thinner brick help conserve resources.

Brick Orientation

A brick has three dimensions: width (sometimes referred to as thickness), height and length. Although brick can be laid in six different orientations (see Figure 1), these dimensions as referenced apply to a brick laid as a stretcher. Height and length are sometimes called face dimensions, because these are the dimensions exposed when the brick is laid as a stretcher.

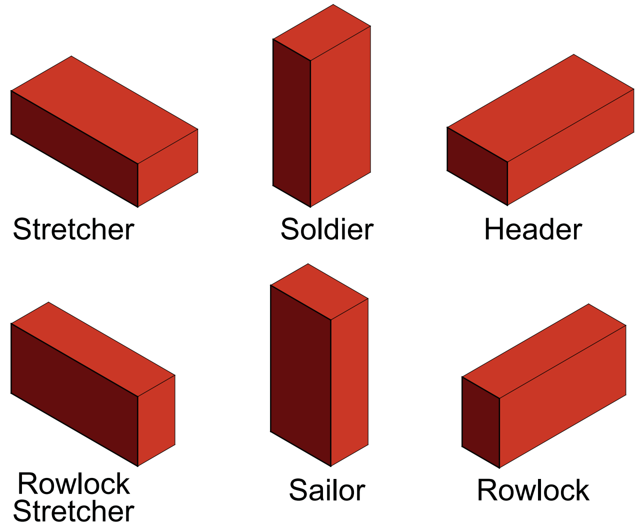

Figure 1
Brick Positions in a Wall

Brick Dimensions

There are three different sets of dimensions used with brick: nominal, specified and actual. Each must be used with care and accuracy to avoid confusion during design and construction.

Nominal dimensions. Nominal dimensions apply to modular brick and are the result of the specified dimension of the brick plus the intended thickness of its intended mortar joint. Generally, these dimensions will fall into "round" numbers to produce modules of 4 in. or 8 in. for imperial units or 100 mm for SI units. They are also a quick way to refer to a given brick size without having to include fractions.

Specified dimensions. Specified dimensions are the anticipated manufactured dimensions of the brick, without consideration for mortar, which are to be used in project specifications and purchase orders. They are also used by the structural engineer in rational design of brick masonry. In non-modular construction, only the specified dimensions are used; thus the absence of corresponding nominal dimensions in Table 2.

Actual dimensions. Actual dimensions are the measurements of the brick as manufactured. Generally the actual dimensions will be within a tolerance of the specified dimensions. The allowable tolerances are dependent upon the type and size of the brick and are given within the applicable ASTM standard specifications, such as those in ASTM C216, *Standard Specification for Facing Brick* and C652, *Standard Specification for Hollow Brick* [Ref. 1].

Bond Pattern

For most brick sizes, one-half running bond is the basic pattern when laying a wall or pavement; i.e., approximately half of the brick's length overlaps the brick below. This pattern is the most frequently used pattern in homes, schools and offices. However, some sizes lend themselves best to other bond patterns. As an example, a utility-sized brick has a nominal length three times its nominal thickness. At corners, where the thickness of the wythe is exposed as the brickwork turns the corner, laying a one-half running bond with utility-sized brick would require cutting at least one brick in every course to maintain bond around the corner. So for utility-sized brick, one-third running bond is much easier to install. These two patterns, as well as some of the more historic patterns that use headers to tie together multiple wythes of masonry, are presented in greater detail in *Technical Note* 30.

Modular and Non-Modular Brick

Modular brick are sized such that the specified dimension plus the intended mortar joint thickness equal a modular dimension. Generally, modular dimensions are whole numbers without fractions that result in modules of 4 in. or 8 in. for imperial units or 100 mm for SI units. A modular brick has a set of nominal, specified and actual dimensions as referenced above. A non-modular brick has a set of specified and actual dimensions but does not have nominal dimensions.

Brick are available in many sizes and are referred to by many different names, depending on region. In addition, the name of a brick and its size, whether modular or non-modular, can vary depending on the manufacturer. Modular brick and their nominal and specified dimensions are shown in Table 1 and Figure 2. Non-modular brick and their specified sizes are shown in Table 2 and Figure 3.

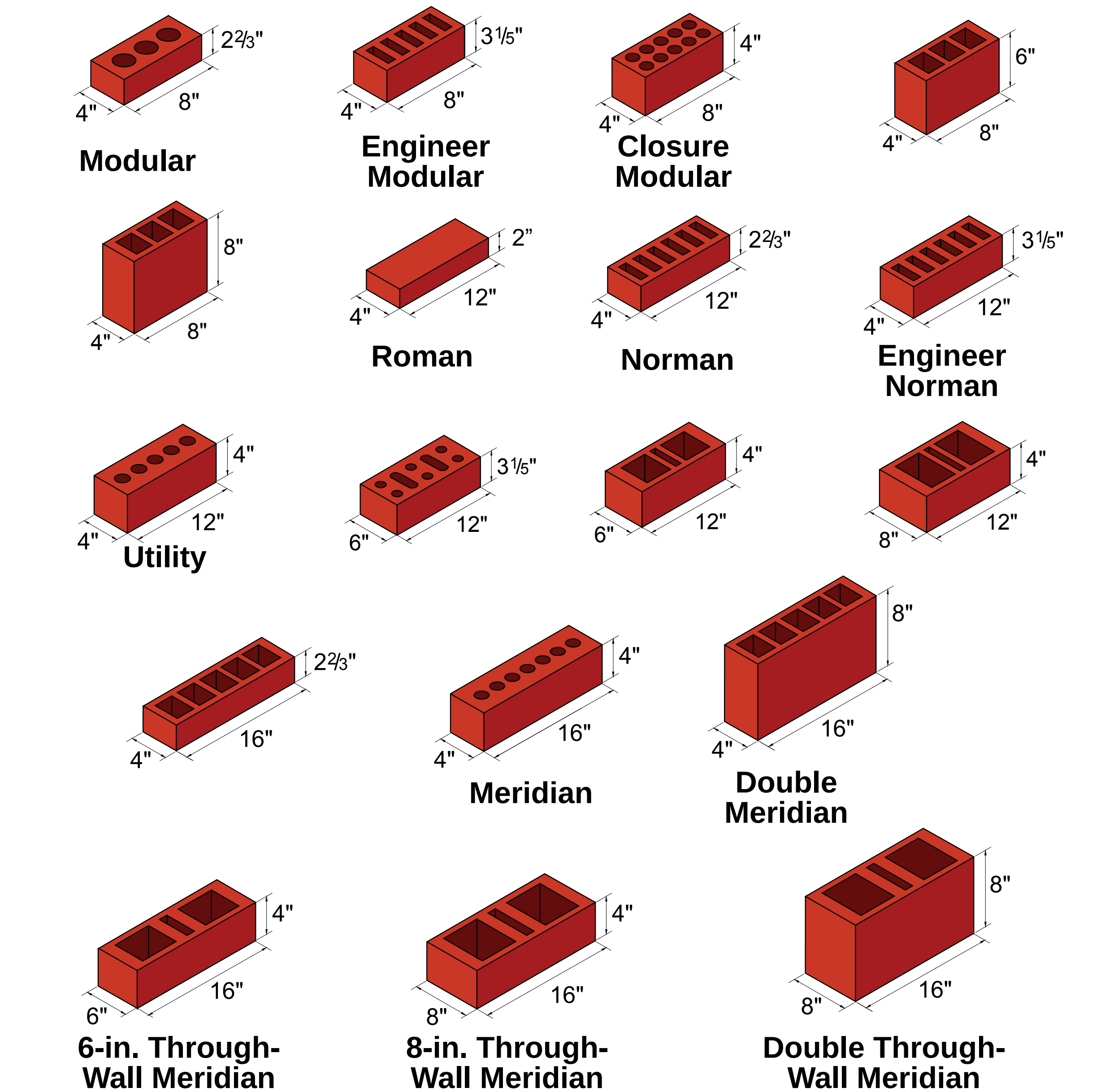

Figure 2

Modular Brick Sizes (Nominal Dimensions)

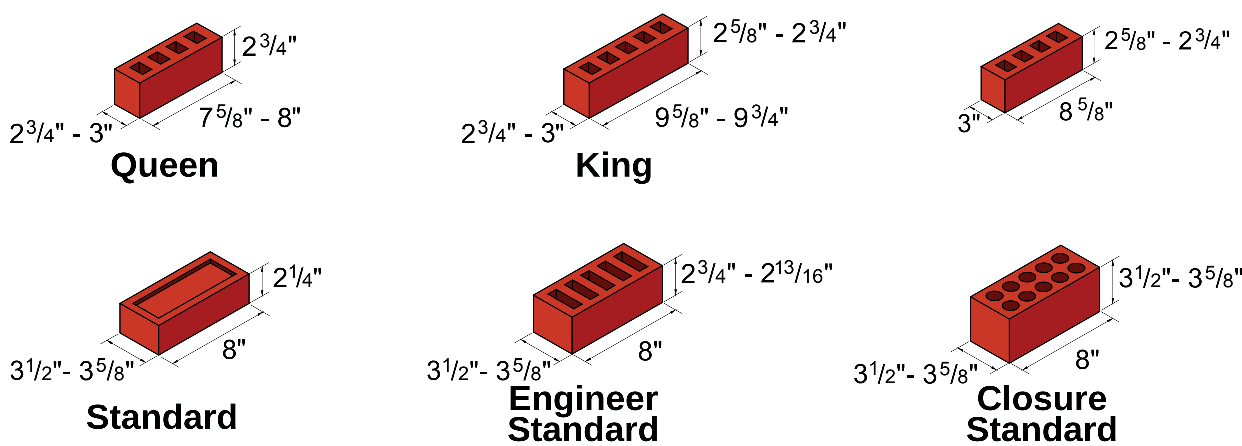

Figure 3

Non-modular Brick Sizes (Specified Dimensions)

Although a size not listed in Table 1 or Table 2 might be desired for a specific project, special sizes are typically avoided where possible in order to not increase costs unnecessarily. The use of specified dimensions when ordering and specifying brick is strongly recommended, since a brick name can vary from manufacturer to manufacturer, and a non-modular brick will not have nominal dimensions. To avoid confusion, specify brick using the stretcher position with width first, followed by height, then length. In other words, a modular brick would be specified as 3⅝ in. × 2¼ in. × 7⅝ in. (92 mm × 57 mm × 194 mm).

TABLE 1
Modular Brick Sizes

Brick Designation[1]	Nominal Dimensions, in. (mm)			Joint Thickness,[3] in. (mm)	Specified Dimensions,[4] in. (mm)			Vertical Coursing
	W	H	L		W	H	L	
Modular	4 (102)	2⅔ (68)	8 (203)	⅜ (9.5) ½ (12.7)	3⅝ (92) 3½ (89)	2¼ (57)	7⅝ (194) 7½ (191)	3C = 8 in. (203 mm)
Engineer Modular	4 (102)	3⅕ (81)	8 (203)	⅜ (9.5) ½ (12.7)	3⅝ (92) 3½ (89)	2¹³⁄₁₆ (71) 2¾ (70)	7⅝ (194) 7½ (191)	5C = 16 in. (406 mm)
Closure Modular	4 (102)	4 (102)	8 (203)	⅜ (9.5) ½ (12.7)	3⅝ (92) 3½ (89)	3⅝ (92) 3½ (89)	7⅝ (194) 7½ (191)	1C = 4 in. (102 mm)
—[2]	4 (102)	6 (152)	8 (203)	⅜ (9.5) ½ (12.7)	3⅝ (92) 3½ (89)	5⅝ (143) 5½ (140)	7⅝ (194) 7½ (191)	2C = 12 in. (305 mm)
—[2]	4 (102)	8 (203)	8 (203)	⅜ (9.5) ½ (12.7)	3⅝ (92) 3½ (89)	7⅝ (194) 7½ (191)	7⅝ (194) 7½ (191)	1C = 8 in. (203 mm)
Roman	4 (102)	2 (51)	12 (305)	⅜ (9.5) ½ (12.7)	3⅝ (92) 3½ (89)	1⅝ (41) 1½ (38)	11⅝ (295) 11½ (292)	2C = 4 in. (102 mm)
Norman	4 (102)	2⅔ (68)	12 (305)	⅜ (9.5) ½ (12.7)	3⅝ (92) 3½ (89)	2¼ (57)	11⅝ (295) 11½ (292)	3C = 8 in. (203 mm)
Engineer Norman	4 (102)	3⅕ (81)	12 (305)	⅜ (9.5) ½ (12.7)	3⅝ (92) 3½ (89)	2¹³⁄₁₆ (71) 2¾ (70)	11⅝ (295) 11½ (292)	5C = 16 in. (406 mm)
Utility	4 (102)	4 (102)	12 (305)	⅜ (9.5) ½ (12.7)	3⅝ (92) 3½ (89)	3⅝ (92) 3½ (89)	11⅝ (295) 11½ (292)	1C = 4 in. (102 mm)
—[2]	6 (152)	3⅕ (81)	12 (305)	⅜ (9.5) ½ (12.7)	5⅝ (143) 5½ (140)	2¹³⁄₁₆ (71) 2¾ (70)	11⅝ (295) 11½ (292)	5C = 16 in. (406 mm)
—[2]	6 (152)	4 (102)	12 (305)	⅜ (9.5) ½ (12.7)	5⅝ (143) 5½ (140)	3⅝ (92) 3½ (89)	11⅝ (295) 11½ (292)	1C = 4 in. (102 mm)
—[2]	8 (203)	4 (102)	12 (305)	⅜ (9.5) ½ (12.7)	7⅝ (194) 7½ (191)	3⅝ (92) 3½ (89)	11⅝ (295) 11½ (292)	1C = 4 in. (102 mm)
—[2]	4 (102)	2⅔ (68)	16 (406)	⅜ (9.5) ½ (12.7)	3⅝ (92) 3½ (89)	2¼ (57)	15⅝ (397) 15½ (394)	3C = 8 in. (203 mm)
Meridian	4 (102)	4 (102)	16 (406)	⅜ (9.5) ½ (12.7)	3⅝ (92) 3½ (89)	3⅝ (92) 3½ (89)	15⅝ (397) 15½ (394)	1C = 4 in. (102 mm)
Double Meridian	4 (102)	8 (203)	16 (406)	⅜ (9.5) ½ (12.7)	3⅝ (92) 3½ (89)	7⅝ (194) 7½ (191)	15⅝ (397) 15½ (394)	1C = 8 in. (203 mm)
6-in. Through-Wall Meridian	6 (152)	4 (102)	16 (406)	⅜ (9.5) ½ (12.7)	5⅝ (143) 5½ (140)	3⅝ (92) 3½ (89)	15⅝ (397) 15½ (394)	1C = 4 in. (102 mm)
8-in. Through-Wall Meridian	8 (203)	4 (102)	16 (406)	⅜ (9.5) ½ (12.7)	7⅝ (194) 7½ (191)	3⅝ (92) 3½ (89)	15⅝ (397) 15½ (394)	1C = 4 in. (102 mm)
Double Through-Wall Meridian	8 (203)	8 (203)	16 (406)	⅜ (9.5) ½ (12.7)	7⅝ (194) 7½ (191)	7⅝ (194) 7½ (191)	15⅝ (397) 15½ (394)	1C = 8 in. (203 mm)

1. Some manufacturers may use a brick designation different from that shown.
2. No brick designation is provided due to inadequate consensus among manufacturers.
3. Common joint sizes used with length and width dimensions. Actual bed joint thicknesses vary based on vertical coursing and actual brick height.
4. Specified dimensions may vary within this range from manufacturer to manufacturer.

TABLE 2
Non-Modular Brick Sizes

Brick Designation[1]	Joint Thickness,[3] in. (mm)	Specified Dimensions,[4] in. (mm)			Vertical Coursing
		W	H	L	
Queen	⅜ (9.5) ½ (12.7)	2¾ (70) 3 (76)	2¾ (70)	7⅝ (194) 8 (203)	5C = 16 in. (406 mm)
King	⅜ (9.5) ½ (12.7)	2¾ (70) 3 (76)	2⅝ (67) 2¾ (70)	9⅝ (244) 9¾ (248)	5C = 16 in. (406 mm)
—[2]	⅜ (9.5) ½ (12.7)	3 (76)	2⅝ (67) 2¾ (70)	8⅝ (219)	5C = 16 in. (406 mm)
Standard	⅜ (9.5) ½ (12.7)	3⅝ (92) 3½ (89)	2¼ (57)	8 (203)	3C = 8 in. (203 mm)
Engineer Standard	⅜ (9.5) ½ (12.7)	3⅝ (92) 3½ (89)	2 13/16 (71) 2¾ (70)	8 (203)	5C = 16 in. (406 mm)
Closure Standard	⅜ (9.5) ½ (12.7)	3⅝ (92) 3½ (89)	3⅝ (92) 3½ (89)	8 (203)	1C = 4 in. (102 mm)

1. Some manufacturers may use a brick designation different from that shown.
2. No brick designation is provided due to inadequate consensus among manufacturers.
3. Common joint sizes used with length and width dimensions. Actual bed joint thicknesses vary based on vertical coursing and actual brick height.
4. Specified dimensions may vary within this range from manufacturer to manufacturer.

MODULAR MASONRY

There are relationships between the width, height and length of brick that were developed as brick masonry construction began. The most common of these dimensional relationships are:

- two brick widths plus one mortar joint equal one brick length, and
- three brick heights plus two mortar joints equal one brick length.

Use of these relationships allows corners and openings in brick walls to be constructed with little waste and limited cutting of brick. These relationships allow rowlocks and headers to tie adjacent wythes together and courses of brick in different orientations to align vertically (see Photo 1). This has given rise to the rich variety of detailing that is part of the architectural vernacular of brickwork.

Because of greater ease in design and construction, the vast majority of contemporary brickwork uses modular-sized brick and modular dimensioning. The most common modular dimension system for brickwork utilizes a 4 in. (102 mm) grid. The 4 in. (102 mm) grid is used in modular coordination between brick and concrete masonry units [Ref. 1] and fits the modular dimensions of other construction materials.

Architect: DiMella Shaffer

Photo 1
Dimensional Relationships

Modular dimensions are sometimes called nominal dimensions, because they represent round numbers without accounting for the fractions of an inch represented by mortar joint thicknesses. For masonry elements, the relationship between modular dimensions and the actual dimensions constructed in the field can depend upon the overall length of the masonry element. For longer masonry wall lengths made of modular-sized brick and about four or more brick lengths long, the actual constructed length of the element often will be the modular dimension. This is possible because during construction, the mason typically will adjust the horizontal layout of the brick to allow slightly larger or smaller head joints so that the brickwork meets the required dimension. For shorter masonry wall lengths made of modular-sized brick and less than about four brick lengths long, the designer may want to consider the specified dimension of the brick and joint thickness when dimensioning the wall. This is because the amount of adjustment necessary to the thickness of head joints between brick will be larger. Additionally, the mason will adjust the number of courses and the bed joint thicknesses in order to meet fixed vertical dimensions. When the completed elevation is viewed, any slight deviation in mortar joint width or the number of courses generally is not obvious in the brickwork.

Overall Dimensioning

The choice of whether nominal or specified dimensions are to be used on drawings is often determined by the type of information that the drawing provides. For drawings that cover large areas, such as elevations and floor plans, use of nominal dimensions is recommended. The overall intent and appearance of the project can be presented without the precision of specified dimensions. When nominal dimensions are used on plans, the drawings must be clearly noted to advise the mason of the intended actual size of the completed masonry elements.

For drawings that provide specific information to other trades, those that coordinate the installation of materials, and for shop drawings, the use of specified dimensions is recommended. An easy manner to remember this is to use nominal dimensions for drawings in which the scale is smaller than ¼ in. per foot. Use specified dimensions for drawings shown in ¼ in. per foot and larger, Of course Computer Aided Drafting (CAD) and Building Information Modeling (BIM) programs often have the specified dimensions of the brick and mortar joint as input options. Thus, at the designer’s discretion, specified dimensions that utilize fractions can be used throughout the drawings to indicate the desired constructed dimensions of the brickwork. However, doing so involves fractions and may complicate the dimensioning process.

Non-Modular Horizontal Dimensioning. Non-modular brick by definition do not conform to a 4 in. (203 mm) module. However, all non-modular brick of a certain size create a module equal to the sum of one brick length and one mortar joint width. This module can be used to establish modular dimensioning for the brickwork in a fashion similar to that used for modular brick. Non-modular brick that are approximately three times as long as they are wide are usually laid in one-third running bond. When laid in one-half running bond, brick near wall ends and openings must usually be cut to maintain the bond.

Vertical Dimensioning. The vertical coursing of both modular and non-modular sized brick is similar. A certain number of courses will correspond to 4, 8, 12 or 16 in. (102, 203, 305 or 406 mm) in height. This dimension establishes the vertical modular grid used on the brickwork. For example, for a non-modular engineer standard brick, a vertical grid of 16 in. (406 mm) is used since five courses of brick equal 16 in. (406 mm). For a wall constructed of modular brick, a vertical grid is established by three courses (three brick and three mortar joints) equaling 8 in. (203 mm). Table 3 gives the vertical dimensions for numbers of courses (stretcher or header positions) and corresponding mortar joints using various sized brick, rounded to the nearest ⅟₁₆ in.

TABLE 3
Vertical Coursing

No. of Courses	Vertical Coursing of Unit							
	2C = 4 in. (102 mm)		3C = 8 in. (203 mm)		5C = 16 in. (406 mm)		1C = 4 in. (102 mm)	
	ft – in.	m	ft – in.	m	ft – in.	m	ft – in.	m
1	0 2	0.051	0 $2\frac{11}{16}$	0.068	0 $3\frac{3}{16}$	0.081	0 4	0.102
2	0 4	0.102	0 $5\frac{5}{16}$	0.135	0 $6\frac{3}{8}$	0.163	0 8	0.203
3	0 6	0.152	0 8	0.203	0 $9\frac{5}{8}$	0.244	1 0	0.305
4	0 8	0.203	0 $10\frac{11}{16}$	0.271	1 $\frac{13}{16}$	0.325	1 4	0.406
5	0 10	0.254	1 $1\frac{5}{16}$	0.339	1 4	0.406	1 8	0.508
6	1 0	0.305	1 4	0.406	1 $7\frac{3}{16}$	0.488	2 0	0.61
7	1 2	0.356	1 $6\frac{11}{16}$	0.474	1 $10\frac{3}{8}$	0.569	2 4	0.711
8	1 4	0.406	1 $9\frac{5}{16}$	0.542	2 $1\frac{5}{8}$	0.65	2 8	0.813
9	1 6	0.457	2 0	0.61	2 $4\frac{13}{16}$	0.732	3 0	0.914
10	1 8	0.508	2 $2\frac{11}{16}$	0.677	2 8	0.813	3 4	1.02
11	1 10	0.559	2 $5\frac{5}{16}$	0.745	2 $11\frac{3}{16}$	0.894	3 8	1.12
12	2 0	0.61	2 8	0.813	3 $2\frac{3}{8}$	0.975	4 0	1.22
13	2 2	0.66	2 $10\frac{11}{16}$	0.881	3 $5\frac{5}{8}$	1.06	4 4	1.32
14	2 4	0.711	3 $1\frac{5}{16}$	0.948	3 $8\frac{13}{16}$	1.14	4 8	1.42
15	2 6	0.762	3 4	1.02	4 0	1.22	5 0	1.52
16	2 8	0.813	3 $6\frac{11}{16}$	1.08	4 $3\frac{3}{16}$	1.3	5 4	1.63
17	2 10	0.864	3 $9\frac{5}{16}$	1.15	4 $6\frac{3}{8}$	1.38	5 8	1.78
18	3 0	0.914	4 0	1.22	4 $9\frac{5}{8}$	1.46	6 0	1.83
19	3 2	0.965	4 $2\frac{11}{16}$	1.29	5 $\frac{13}{16}$	1.54	6 4	1.93
20	3 4	1.02	4 $5\frac{5}{16}$	1.36	5 4	1.63	6 8	2.03
21	3 6	1.07	4 8	1.42	5 $7\frac{3}{16}$	1.71	7 0	2.13
22	3 8	1.12	4 $10\frac{11}{16}$	1.49	5 $10\frac{3}{8}$	1.79	7 4	2.24
23	3 10	1.17	5 $1\frac{5}{16}$	1.56	6 $1\frac{5}{8}$	1.87	7 8	2.34
24	4 0	1.22	5 4	1.63	6 $4\frac{13}{16}$	1.95	8 0	2.44
25	4 2	1.27	5 $6\frac{11}{16}$	1.69	6 8	2.03	8 4	2.54
26	4 4	1.32	5 $9\frac{5}{16}$	1.76	6 $11\frac{3}{16}$	2.11	8 8	2.64
27	4 6	1.37	6 0	1.83	7 $2\frac{3}{8}$	2.2	9 0	2.74
28	4 8	1.42	6 $2\frac{11}{16}$	1.9	7 $5\frac{5}{8}$	2.28	9 4	2.85
29	4 10	1.47	6 $5\frac{5}{16}$	1.96	7 $8\frac{13}{16}$	2.36	9 8	2.95
30	5 0	1.52	6 8	2.03	8 0	2.44	10 0	3.05
31	5 2	1.58	6 $10\frac{11}{16}$	2.1	8 $3\frac{3}{16}$	2.52	10 4	3.15
32	5 4	1.63	7 $1\frac{5}{16}$	2.17	8 $6\frac{3}{8}$	2.6	10 8	3.25
33	5 6	1.68	7 4	2.24	8 $9\frac{5}{8}$	2.68	11 0	3.35
34	5 8	1.73	7 $6\frac{11}{16}$	2.3	9 $\frac{13}{16}$	2.76	11 4	3.45
35	5 10	1.78	7 $9\frac{5}{16}$	2.37	9 4	2.85	11 8	3.56
36	6 0	1.83	8 0	2.44	9 $7\frac{3}{16}$	2.93	12 0	3.66
37	6 2	1.88	8 $2\frac{11}{16}$	2.51	9 $10\frac{3}{8}$	3.01	12 4	3.76
38	6 4	1.93	8 $5\frac{5}{16}$	2.57	10 $1\frac{5}{8}$	3.09	12 8	3.86
39	6 6	1.98	8 8	2.64	10 $4\frac{13}{16}$	3.17	13 0	3.96
40	6 8	2.03	8 $10\frac{11}{16}$	2.71	10 8	3.25	13 4	4.06

TABLE 3 (continued)
Vertical Coursing

No. of Courses	Vertical Coursing of Unit: 2C = 4 in. (102 mm) ft – in.	2C = 4 in. (102 mm) m	3C = 8 in. (203 mm) ft – in.	3C = 8 in. (203 mm) m	5C = 16 in. (406 mm) ft – in.	5C = 16 in. (406 mm) m	1C = 4 in. (102 mm) ft – in.	1C = 4 in. (102 mm) m
41	6 10	2.08	9 1 5/16	2.78	10 11 3/16	3.33	13 8	4.17
42	7 0	2.13	9 4	2.85	11 2 3/8	3.41	14 0	4.27
43	7 2	2.18	9 6 11/16	2.91	11 5 5/8	3.5	14 4	4.37
44	7 4	2.24	9 9 5/16	2.98	11 8 3/16	3.58	14 8	4.47
45	7 6	2.29	10 0	3.05	12 0	3.66	15 0	4.57
46	7 8	2.34	10 2 11/16	3.12	12 3 3/16	3.74	15 4	4.67
47	7 10	2.39	10 5 5/16	3.18	12 6 3/8	3.82	15 8	4.78
48	8 0	2.44	10 8	3.25	12 9 5/8	3.9	16 0	4.88
49	8 2	2.49	10 10 11/16	3.32	13 13/16	3.98	16 4	4.98
50	8 4	2.54	11 1 5/16	3.39	13 4	4.06	16 8	5.08
100	16 8	5.08	22 2 11/16	6.77	26 8	8.13	33 4	10.2

Masonry Openings

The edges of masonry openings are defined by brick units rather than mortar joints. Vertical dimensions are based on the number of courses plus an extra bed joint thickness. Figure 4 shows an example of dimensions for a punched window opening for modular sized brick units. Note that the height is for the opening before the installation of the sill and extends up to the bottom of the brick above, not to the bottom of the lintel supporting the brick.

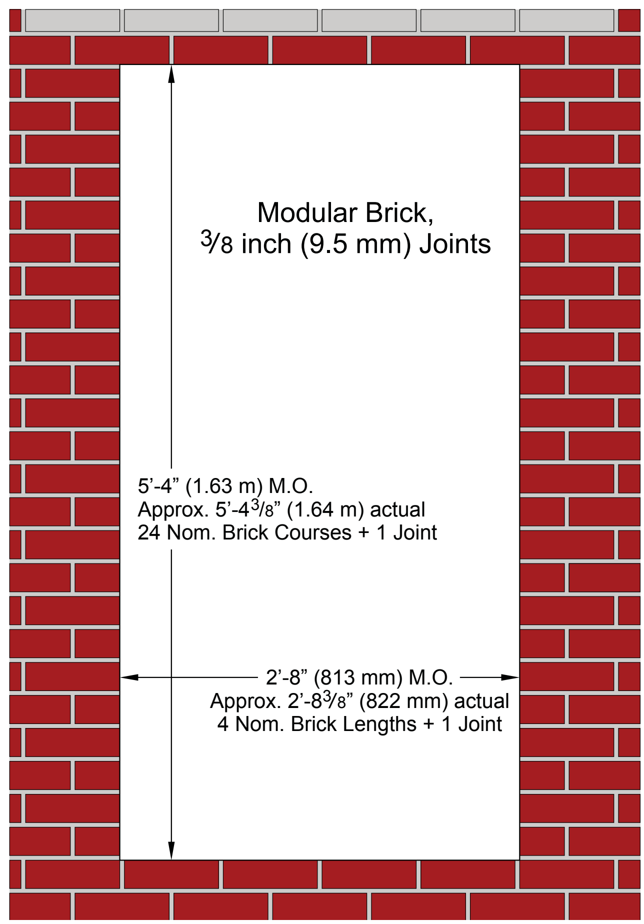

Figure 4
Example of Determining Dimensions for a Masonry Opening

ESTIMATING BRICK MASONRY

There are various methods to estimate material quantities on a project. Hand calculations and computer programs have been used depending on the complexity of the building. Because of its simplicity and accuracy, the most widely used estimating procedure is the "wall-area" method. It consists simply of multiplying the net wall area (gross areas less areas of openings) by known quantities of material required per square foot (square meter).

Determining the area of brick and mortar within each unit area of wall depends on both brick size and joint width. For non-modular masonry, both dimensions must be known to make accurate estimates. In modular masonry, mortar joint sizes are dictated by the size of the brick, simplifying the estimating process.

Brick and Mortar Quantities

Masons frequently use a rule of thumb that eight bags of masonry cement will lay 1000 modular brick. This is a very rough estimate and includes an unspecified amount of waste. Table 4 presents the estimated quantities of brick and mortar (not including waste) required for brick masonry according to the size of brick used in the wall. The mortar quantities are based on theoretical dimensions of the mortar in the wall. Estimates made using Table 4 should also include applicable correction factors listed in the Correction Factor section. For guidance on the volume of each solid material required for a specific mortar type, refer to ASTM C270, *Standard Specification for Mortar for Unit Masonry* [Ref. 1]. The commonly used "rule of thumb" is appropriate: 1 cubic foot (cubic meter) of loose, damp sand will yield about one cubic foot (cubic meter) of mortar.

TABLE 4
Quantity Estimates for Brick Masonry

MODULAR BRICK SIZES							
Brick Designation	**Nominal Dimensions, in. (mm)**			**Joint Thickness, in. (mm)**	**Number of Brick per 100 sq ft (per 10 m²)**	**Cubic Feet (Cubic Meters) of Mortar**	
	W	**H**	**L**			**Per 100 sq ft (10 m²)**	**Per 1000 Brick**
Modular	4 (102)	2⅔ (68)	8 (203)	⅜ (9.5) ½ (12.7)	675 (727)	5.5 (1.7) 6.9 (2.1)	8.1 (0.23) 10.3 (0.29)
Engineer Modular	4 (102)	3⅕ (81)	8 (203)	⅜ (9.5) ½ (12.7)	563 (605)	4.8 (1.5) 6.1 (1.9)	8.5 (0.24) 10.8 (0.31)
Closure Modular	4 (102)	4 (102)	8 (203)	⅜ (9.5) ½ (12.7)	450 (484)	4.1 (1.3) 5.2 (1.6)	9.1 (0.26) 11.6 (0.33)
—	4 (102)	6 (152)	8 (203)	⅜ (9.5) ½ (12.7)	300 (323)	3.2 (0.98) 4.1 (1.3)	10.7 (0.30) 13.7 (0.39)
—	4 (102)	8 (203)	8 (203)	⅜ (9.5) ½ (12.7)	225 (242)	2.8 (0.84) 3.5 (1.1)	12.3 (0.35) 15.7 (0.44)
Roman	4 (102)	2 (51)	12 (305)	⅜ (9.5) ½ (12.7)	600 (646)	6.4 (2.0) 8.2 (2.5)	10.7 (0.30) 13.7 (0.39)
Norman	4 (102)	2⅔ (68)	12 (305)	⅜ (9.5) ½ (12.7)	450 (484)	5.1 (1.5) 6.5 (2.0)	11.2 (0.32) 14.3 (0.41)
Engineer Norman	4 (102)	3⅕ (81)	12 (305)	⅜ (9.5) ½ (12.7)	375 (404)	4.4 (1.3) 5.6 (1.7)	11.7 (0.33) 14.9 (0.42)
Utility	4 (102)	4 (102)	12 (305)	⅜ (9.5) ½ (12.7)	300 (323)	3.7 (1.1) 4.7 (1.4)	12.3 (0.35) 15.7 (0.44)
—	6 (152)	3⅕ (81)	12 (305)	⅜ (9.5) ½ (12.7)	375 (404)	6.8 (2.1) 8.8 (2.7)	18.1 (0.51) 23.4 (0.66)
—	6 (152)	4 (102)	12 (305)	⅜ (9.5) ½ (12.7)	300 (323)	5.7 (1.7) 7.4 (2.3)	19.1 (0.54) 24.7 (0.70)
—	8 (203)	4 (102)	12 (305)	⅜ (9.5) ½ (12.7)	300 (323)	7.8 (2.4) 10.1 (3.1)	25.9 (0.73) 33.6 (0.95)
—	4 (102)	2⅔ (68)	16 (406)	⅜ (9.5) ½ (12.7)	338 (363)	4.9 (1.6) 6.5 (2.1)	14.5 (4.7) 19.2 (6.2)
Meridian	4 (102)	4 (102)	16 (406)	⅜ (9.5) ½ (12.7)	225 (242)	3.5 (1.1) 4.4 (1.4)	15.4 (0.44) 19.7 (0.56)
Double Meridian	4 (102)	8 (203)	16 (406)	⅜ (9.5) ½ (12.7)	113 (121)	2.1 (0.64) 2.7 (0.82)	18.6 (0.53) 23.8 (0.67)
6-in. Through-Wall Meridian	6 (152)	4 (102)	16 (406)	⅜ (9.5) ½ (12.7)	225 (242)	5.4 (1.6) 7.0 (2.1)	24.0 (0.68) 31.0 (0.88)
8-in. Through-Wall Meridian	8 (203)	4 (102)	16 (406)	⅜ (9.5) ½ (12.7)	225 (242)	7.3 (2.2) 9.5 (2.9)	32.5 (0.92) 42.3 (1.2)
Double Through-Wall Meridian	8 (203)	8 (203)	16 (406)	⅜ (9.5) ½ (12.7)	113 (121)	4.4 (1.3) 5.7 (1.8)	39.1 (1.1) 51.0 (1.4)

TABLE 4 (continued)

Quantity Estimates for Brick Masonry

NON-MODULAR BRICK SIZES							
Brick Designation	Specified Dimensions, in. (mm)			Joint Thickness, in. (mm)	Number of Brick per 100 sq ft (per 10 m²)	Cubic Feet (Cubic Meters) of Mortar	
	W	H	L			Per 100 sq ft (10 m²)	Per 1000 Brick
Queen	2¾ (70) 3 (76)	2¾ (70)	7⅝ (194) 8 (203)	⅜ (9.5) ½ (12.7)	550 (592)	6.7 (2.1) 7.4 (2.3)	12.2 (0.35) 13.5 (0.38)
King	2¾ (70) 3 (76)	2⅝ (67) 2¾ (70)	9⅝ (244) 9¾ (248)	⅜ (9.5) ½ (12.7)	455 (490)	6.5 (2.0) 7.3 (2.2)	14.2 (0.40) 16.0 (0.45)
—	3 (76)	2⅝ (67) 2¾ (70)	8⅝ (219)	⅜ (9.5) ½ (12.7)	512 (551)	6.6 (2.0) 8.2 (2.5)	13.0 (0.37) 16.1 (0.46)
Standard	3⅝ (92) 3½ (89)	2¼ (57)	8 (203)	⅜ (9.5) ½ (12.7)	655 (705)	9.5 (2.9) 11.0 (3.3)	14.5 (0.41) 17.8 (0.50)
Engineer Standard	3⅝ (92) 3½ (89)	2¹³⁄₁₆ (71) 2¾ (70)	8 (203)	⅜ (9.5) ½ (12.7)	539 (581)	8.2 (2.5) 9.7 (3.0)	15.3 (0.43) 18.7 (0.53)
Closure Standard	3⅝ (92) 3½ (89)	3⅝ (92) 3½ (89)	8 (203)	⅜ (9.5) ½ (12.7)	430 (463)	7.0 (2.2) 8.5 (2.6)	16.4 (0.46) 20.0 (0.57)

Collar Joints. For multi-wythe construction, where the vertical joint between wythes is designed to be mortared solid, the values in Table 5 can be used to estimate the quantity of mortar within the collar joint.

TABLE 5

Mortar Quantities in Collar Joints

Cubic Feet of Mortar per 100 sq ft (m² per 10 m²) of Wall			
¼-in. (6.4 mm) joint	⅜-in. (9.5 mm) joint	½-in. (12.7 mm) joint	¾-in. (19.1 mm) joint
2.08 (0.064)	3.13 (0.095)	4.17 (0.13)	6.25 (0.19)

Correction Factors

Hollow Brick. The mortar quantities in Table 4 are based on fully bedded, solid masonry units (coring up to 25 percent of the bedded area). In veneer applications, hollow brick should also be laid in full mortar beds. Field testing has demonstrated that a veneer constructed of hollow brick units with a nominal thickness of 3 to 4 in. (76 to 102 mm) and cores or cells between 25 and 35 percent of the bedded area and laid in a full mortar bed does not significantly increase mortar usage compared to the same veneer constructed of solid brick units. Care should be taken to avoid using excessively plastic mortar or placement methods that would force excessive amounts of mortar into the cells or cores of the brick below. If these steps are taken, the estimates of Table 4 are valid for most hollow brick veneer applications. For hollow units laid with face shell bedding (as typically done in structural applications), the estimated quantities can be reduced by a percentage equal to the percentage of voids in the brick. This reduction will typically be between 25 and 35 percent.

Bond Pattern. The values in Table 4 are based on running or stack bond patterns. For patterns that incorporate headers, the correction factors in Table 6 can be applied. The factor is a net increase for the number of brick and the mortar quantity, not including waste. For definitions of the patterns cited, refer to *Technical Note* 30. For example, for a standard-size brick laid with a ⅜ in. (9.5 mm) joint thickness in a common bond with full headers every fifth course, the following estimates would apply:

- Number of brick per 100 sq ft (9.30 m²) of brickwork: 655 + (⅕ × 655) = 786 brick
- Cubic feet (0.028 m³) of mortar per 1000 brick: 14.5 + (1⁄15 × 14.5) = 15.5

TABLE 6

Estimate Correction Factors for Bond Patterns

Bond	Brick Correction Factor[1]	Mortar Correction Factor[2]
Common Bond with full headers every fifth course only	1/5	1/15
Common Bond with full headers every sixth course only	1/6	1/18
Common Bond with full headers every seventh course only	1/7	1/21
English Bond (full headers every second course)	1/2	1/6
Flemish Bond (alternate full headers and stretchers every course)	1/3	1/9
Cross Bond with Flemish headers every sixth course	1/18	1/54
Flemish Cross Bond (Flemish headers every second course)	1/6	1/18
Double-stretcher, garden wall bond	1/5	1/15
Triple-stretcher, garden wall bond	1/7	1/21

1. The net increase for brick units may be less than that given when multiple headers can be made from a single brick.
2. Correction factors are applicable only to brick with lengths equal to twice the depth and 2½ to three times the height.

Brick Breakage and Waste. In the estimating procedure, determine the net quantities of all brick, including all correction factors above, before adding any allowances for waste. Allowances for waste and breakage vary, but as a general rule, at least 5 percent is added to the net brick quantities delivered to the jobsite. Particular job conditions or experience may warrant using a higher percentage for waste.

Mortar Waste. In the estimating procedure, determine the net quantities of all materials, including all correction factors above, before adding any allowances for waste. Allowances for waste vary, but as a general rule, add 15 to 25 percent to the net mortar quantities. Particular job conditions, or experience, may dictate different factors.

SUMMARY

This *Technical Note* provides a discussion of brick sizes and modular masonry construction and a discussion of the basic layout of brick masonry walls. Methods are presented for estimating quantities of brick and mortar materials for a chosen brick size, mortar joint size and bond pattern.

> *The information and suggestions contained in this* Technical Note *are based on the available data and the experience of the engineering staff and members of the Brick Industry Association. The information contained herein must be used in conjunction with good technical judgment and a basic understanding of the properties of brick masonry. Final decisions on the use of the information discussed in this* Technical Note *are not within the purview of the Brick Industry Association and must rest with the project architect, engineer and owner.*

REFERENCES

1. Annual Volume of ASTM Standards, ASTM International, West Conshohoken, PA, 2008.

Volume 04.05
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