1	1 — Scope	56	ASTM C216-17a -Specification for Facing Brick
2	This Standard provides minimum requirements for	57	(Solid Masonry Units Made from Clay or Shale)
3	rating masonry assemblies constructed using one or	58	
4	more masonry units complying with Section 5.1 for	59	ASTM C270-14a – Specification for Mortar for Unit
5	sound transmission class, STC, and outdoor-indoor	60	Masonry
6	transmission class, OITC. These ratings are for	61	
7	masonry assemblies in structures erected under the	62	ASTM C331/C331M-17 – Specification for
8	requirements of the legally-adopted building code of	63	Lightweight Aggregates for Concrete Masonry
9	which this Standard forms a part. In areas without a	64	Units
10	legally-adopted building code, this Standard defines	65	
11	minimum acceptable methods to determine the STC	66	ASTM C476-18 – Standard Specification for Grout for
12	and OITC ratings of masonry assemblies. All masonry	67	Masonry
13	dimensions referred to in this standard are nominal	68	
14	unless indicated otherwise.	69	ASTM C516-08(2013)e1 – Specification for Vermiculite
15		70	Loose Fill Thermal Insulation
16		71	
17	2 — Reference Standards	72	ASTM C549-06(2012) – Specification for Perlite Loose
18	Standards of ASTM International and The Masonry	73	Fill Insulation
19	Society cited in this standard are listed below with	74	
20	their serial designations, including year of	75	ASTM C652-17a – Specification for Hollow Brick
21	adoption or revision, and are declared to be part	76	(Hollow Masonry Units Made from Clay or Shale)
22	of this standard as if fully set forth in this	77	
23	document.	78	ASTM C744-16 – Specification for Prefaced Concrete
24		79	and Calcium Silicate Masonry Units
25	ASTM C33/C33M-18 – Specification for Concrete	80	
26	Aggregates	81	ASTM C920-14a – Specification for Elastomeric Joint
27		82	Sealants
28	ASTM C34-17 – Specification for Structural Clay	83	Y
29	Loadbearing Wall Tile	84	ASTM C1405-16 – Specification for Glazed Brick
30		85	(Single Fired, Brick Units)
31	ASTM C55-17 – Specification for Concrete Building	86	
32	Brick	87	ASTM C1634-16 – Specification for Concrete Facing
33		88	Brick
34	ASTM C56-13(2017) – Specification for Structural	89	
35	Clay Nonloadbearing Tile	90	ASTM C1714/C1714M-16 - Specification for
36		91	Preblended Dry Mortar Mix for Unit Masonry
37	ASTM C62-17 – Specification for Building Brick	92	
38	(Solid Masonry Units Made from Clay or Shale)	93	ASTM E90-09(2016) - Test Method for Laboratory
39		94	Measurement of Airborne Sound Transmission
40	ASTM C73-17 – Specification for Calcium Silicate	95	Loss of Building Partitions and Elements
41	Brick (Sand-Lime Brick)	96	
42		97	ASTM E336-16a - Test Method for Measurement of
43	ASTM C90-16a - Specification for Loadbearing	98	Airborne Sound Attenuation between Rooms in
44	Concrete Masonry Units	99	Buildings
45		100	
46	ASTM C126-17 – Specification for Ceramic Glazed	101	ASTM E413-16 - Classification for Rating Sound
47	Structural Clay Facing Tile, Facing Brick, and	102	Insulation
48	Solid Masonry Units	103	
49		104	ASTM E966-18 - Guide for Field Measurements of
50	ASTM C129-17 – Specification for Nonloadbearing	105	Airborne Sound Insulation of Building Facades
51	Concrete Masonry Units	106	and Facade Elements
52		107	
53	ASTM C212-17 – Specification for Structural Clay	108	ASTM E1332-16 - Classification for Rating Outdoor-
54	Facing Tile	109	Indoor Sound Attenuation
55		110	
		111	TMS 602-16 – Specification for Masonry Structures

#### 3 — Notations

3	3 — Notations
4	DSTC = the change in STC rating from a bare
5	concrete masonry assembly (dB)
	d = the thickness of a single furring space;
7	where a furring space is provided on both sides of an
8	assembly, d shall be taken equal to the thickness of one
9	furring space layer, in. (mm)
	FSTC = Field Sound Transmission Class (dB)
11	OITC = Outdoor-Indoor Transmission Class (dB)
12 13	STC       =       Sound Transmission Class (dB)         STL       =       Sound Transmission Loss (dB)
13	W = Average Assembly Weight per Surface
15	Area, psf (kg/m <sup>2</sup> )
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	$\mathbb{Q}^{\times}$
	assembly, d shall be taken equal to the thickness of one furring space layer, in. (mm) <i>FSTC</i> = Field Sound Transmission Class (dB) <i>OITC</i> = Outdoor-Indoor Transmission Class (dB) <i>STL</i> = Sound Transmission Loss (dB) <i>W</i> = Average Assembly Weight per Surface Area, psf (kg/m <sup>2</sup> )
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# 1 4 — Definitions

1	4 — Definitions
2	Average assembly weight, W — The average
3	assembly weight based on the weight of the masonry
4	units, the weight of mortar, grout, loose fill material in
5	voids within the assembly, and the weight of plaster,
6	stucco, and paint. The weight of gypsum wallboard
7	shall not be included.
	shall not be included.
8	
9	<i>Coarse textured</i> – a relative term referring to the
10	porosity of the matrix through the thickness of the
11	masonry, which is related to the airflow through a
12	masonry unit.
13	
14	Field Sound Transmission Class, FSTC — Sound
15	transmission class calculated using values of field
16	transmission loss.
18	
18	Outdoor-Indoor Transmission Class, OITC — A
20	single-number rating calculated in accordance with
21	ASTM E1332 using values of sound transmission
22	loss.
23	
24	Sound absorbing material - Fibrous materials,
25	such as cellulose fiber, glass fiber, or rock wool
26	insulation.
27	
28	Sound Transmission Class, STC — A single-
29	number rating calculated in accordance with ASTM
30	E413 using values of sound transmission loss.
31	
32	Sound Transmission Loss, STL — A measure
33	equal to ten times the common logarithm of the ratio
34	of the airborne sound power, in a specified frequency
35	band, incident on the assembly to the sound power
36	transmitted by the assembly and radiated on the
37	opposite side of the assembly .
38	opposite side of the assentory.
39	· · · · · · · · · · · · · · · · · · ·
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41	5 — Materials
42	5.1 Masonry Units
43	Masonry units shall comply with the
44	requirements of one of the following standards:
45	ASTM C34, ASTM C55, ASTM C56, ASTM
46	C62, ASTM C73, ASTM C90, ASTM C126,
47	ASTM C129, ASTM C212, ASTM C216, ASTM
48	C652, ASTM C744, ASTM C1405, or ASTM
49	C1634.
50	
51	5.2 Mortar
52	Mortar shall comply with the requirements of
53	ASTM C270 or ASTM C1714/C1714M.
55 54	$1 \cup 1 \cup 1 \cup 2 \cup 0 \cup 1 \cup 1$
54 55	5.3 Grout
55 56	
	Grout shall comply with the requirements of
57	ASTM C 476.

### 5.4 Joint Sealants

Joint sealants shall comply with the requirements of ASTM C 920.

### 5.5 Loose Fill Materials

Loose fill materials used to fill voids in masonry construction shall comply with ASTM C33/C33M, ASTM C331/C331M, ASTM C516, or ASTM C549.

## 6 — Construction

Construction shall conform to the requirements of 72 TMS 602 for concrete masonry and clay masonry and 73 shall conform to the requirements of this Standard 74 when applying the STC ratings of Section 7 or the OITC ratings of Section 8. 75

# 6.1 Sealing penetrations and joints

**6.1.1** Through-wall and membrane penetrations shall be sealed with joint sealant, mortar, or grout. Prior to sealing around penetrations, the perimeter space behind the surface sealant shall be filled with foam, cellulose fiber, glass fiber, ceramic fiber, or mineral wool.

6.1.2 Movement joints and joints between the top of masonry assemblies and roof or floor assemblies shall be sealed with joint sealant. The space behind the sealant shall be filled with mortar, grout, foam, cellulose fiber, glass fiber, or mineral wool. Noncompressible filler materials shall not be used in movement or expansion joints of clay masonry assemblies or at the top of nonloadbearing partitions.

# 6.2 Surface coatings

Coarse-textured concrete masonry assemblies shall be covered on or both faces with gypsum wallboard attached directly to the surface or shall be sealed on one or both faces with at least one coat of acrylic latex, alkyd or cement based paint, plaster, or other suitable coating.

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# 1 7 — Sound Transmission Class Ratings

2 The sound transmission class, *STC*, ratings of 3 masonry assemblies shall be determined in accordance 4 with Section 7.1, 7.2, or 7.3.

### 7.1 Laboratory testing

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7 The *STC* ratings of masonry assemblies shall 8 be determined based on laboratory testing of an 9 assembly that is representative of the actual 10 construction. Testing shall be conducted in accordance 11 with the requirements of ASTM E90 and STC values 12 calculated in accordance with ASTM E413.7.2 13 Field testing

14The STC ratings of field-evaluated masonry15assemblies shall be conducted in accordance with16the requirements of ASTM E336 and calculated17in accordance with ASTM E413.

## 7.3 Calculation

# 7.3.1 Clay Masonry Construction

The *STC* ratings for clay masonry assemblies shall be determined in accordance with Eq. 1. The minimum nominal thickness of the clay masonry assembly shall not be less than 3 in. (76 mm).

 $STC = 19.6W^{0.230}$  Eq. 1. SI  $STC = 13.6W^{0.230}$ 

### 7.3.2 Concrete Masonry Construction

The *STC* ratings for concrete masonry assemblies shall be determined in accordance with Eq. 2. The minimum nominal thickness of the concrete masonry assembly shall not be less than 4 in. (102 mm).

$$STC = 20.5W^{0.234}$$
 Eq. 2.  
SI  $STC = 14.1W^{0.234}$ 

**7.3.2.1 Effect of Gypsum Wallboard on** *STC* **Ratings of Concrete Masonry Assemblies** When *STC* ratings are determined by Eq. 2, gypsum wallboard attached directly to the concrete masonry shall be assumed to not change the *STC* rating.

The change in the sound transmission class, *STC*, ratings for 1/2-in. (13 mm) or 5/8-in. (16 mm) thick gypsum wallboard attached to concrete masonry assemblies with furring shall be determined using Eq. 3, 4, 5, or 6 as appropriate. Where sound absorbing material is used, it shall fill the entire furring space. When gypsum wallboard is applied to both sides of the assembly, the specified thickness of the furring space, d, shall be identical on each side of the assembly.

For gypsum wallboard on one side of the assembly with no sound absorbing material in the furring space:

$$DSTC = 2.8d - 1.22$$
 Eq. 3  
SI  $DSTC = 0.11d - 1.22$ 

For gypsum wallboard on both sides of the assembly and no sound absorbing material in the furring spaces:

> DSTC = 3.6d - 2.78 Eq. 4 SI DSTC = 0.14d - 2.78

For gypsum wallboard on one side of the assembly with sound absorbing material in the furring space:

$$DSTC = 3.0d + 1.87$$
 Eq. 5  
SI  $DSTC = 0.12d + 1.87$ 

For gypsum wallboard on both sides of the assembly and sound absorbing material in the furring spaces:

DSTC = 11.2d - 7.37 Eq. 6 SI DSTC = 0.44d - 7.37

# 7.3.3 Multi-Wythe Masonry Construction

The *STC* ratings for multi-wythe assemblies consisting of concrete masonry and clay masonry wythes shall be determined in accordance with Eq. 1 and Eq. 2 using the total weight of all wythes for the average assembly weight, *W*. The resulting *STC* rating shall be linearly interpolated between each independently calculated *STC* rating based on the relative weights of the two materials in the assembly.

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1	8 — Outdoor-Indoor Transmission Class
2	Ratings
3	The Outdoor-Indoor Transmission Class, OITC,
4	ratings of masonry assemblies shall be determined in
5	accordance with Section 8.1, 8.2, or 8.3.
6	
7	8.1 Laboratory testing
8	The OITC ratings of masonry assemblies
9	shall be determined based on laboratory testing of
10	an assembly that is representative of the actual
11	construction. Testing shall be conducted in
12	accordance with the requirements of ASTM E90
13	and OITC values calculated in accordance with
14	ASTM E1332.
15	
16	8.2 Field testing
17	The OITC ratings of field-evaluated masonry
18	assemblies shall be conducted in accordance with
19	the requirements of ASTM E966 and calculated

in accordance with ASTM E1332.

## 8.3 Calculation

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## 8.3.1 Clay Masonry Construction

The OITC ratings for clay masonry 25 assemblies shall be determined in accordance with 26 27 Eq. 7. The minimum nominal thickness of the clay 28 masonry assembly shall not be less than 3 in. (76 Republic 29 mm). 30

$$OITC = 17.4W^{0.224}$$
 Eq. 7.  
SI  $OITC = 12.2W^{0.224}$ 

#### 8.3.2 Concrete Masonry Construction

The OITC ratings for concrete masonry assemblies shall be determined in accordance with Eq. 8. The minimum nominal thickness of the concrete masonry assembly shall not be less than 4 in. (102 mm).

$$OITC = 14.7W$$
 Eq. 8.  
SI  $OITC = 9.28W$  0.290

## 8.3.3 Multi-Wythe Masonry Construction

The OITC ratings for multi-wythe assemblies consisting of concrete masonry and clay masonry wythes shall be determined in accordance with Eq. 7 and Eq. 8 using the total weight of all wythes for the average assembly weight, W. The resulting OITC rating shall be interpolated between each independently calculated OITC rating based on the relative weights of the two materials in the assembly.

- Commentary 1 Standard Method for Determining 2 Sound Transmission Ratings 3 4 for Masonry Assemblies (TMS 0302-XX) 5 6 7 8 This commentary accompanies the Standard and provides an explanation of and justification for the requirements of the Standard. This commentary is not intended to be part of the Standard. 9 The Standard is a concise statement of requirements and is intended to be adopted by reference 10 in construction documents, building codes, and other standards. This commentary provides 11 background information including illustrations and example applications of the requirements of 12 the Standard and is not intended to be adopted by reference in other documents. The commentary 13 ard. ard. ard. commont commont commont public is intended to assist the designer and other users of the Standard in applying the Standard and in 14 15
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#### 1 — Scope 2

3 Sound ratings of masonry assemblies are based on 4 field or laboratory testing in accordance with standard test methods or by calculation. Performance of 5 masonry assemblies in resisting sound transmission 6 7 depends on the frequency and magnitude of the sound, detailing practices to mitigate the transmission of 8 9 sound, and the sound transmission loss characteristics 10 of the masonry assembly.

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12 Sound transmission loss, STL, is the decrease or 13 attenuation in sound energy expressed in decibels (dB) of air borne sound as it passes through an 14 assembly. Sound transmission loss is determined in 15 16 accordance with ASTM E90 at specified frequencies. 17 In general, STL for masonry assemblies increases as 18 the frequency of the sound increases.

19 Sound transmission class, STC, is determined by 20 ASTM E413. It provides an estimate of the 21 performance of an assembly in certain common 22 sound insulation applications. Although STC is a 23 convenient index to relative sound transmission, the 24 STL spectra should be studied in order to meet 25 particular sound transmission requirements.

Outdoor-indoor transmission class, OITC, is 26 27 determined in accordance with ASTM E1332. ASTM E1332 presents a standard procedure to determine 28 OITC based on measured sound transmission loss, 29 STL, across an assembly at frequencies from 80 to 30 4,000 Hz. OITC is calculated using tested STL values 31 32 and the sound spectrum of a reference sound source. 33 This reference sound spectrum is an average of typical 34 spectra from three transportation noise sources: aircraft takeoff, freeway, and railroad passby. The 35 reference sound spectrum is A-weighted to better 36 37 correlate with human hearing (A-weighting is a 38 frequency response adjustment that accounts for the changes in human hearing sensitivity as a function of 39 40 frequency).

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#### 42 2 — Reference Standards 43 No commentary.

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#### 47 3 — Notations

- 48 No commentary.
- 49 50

#### 51 4 — Definitions

52 The weight of the gypsum wallboard is not to be 53 included in the calculated sound rating of the 54 assembly. The effect of gypsum wallboard, a cavity and sound absorbing insulation is considered as an 55 56 adjustment to the STC rating of the bare masonry 57 assembly. The air space between the gypsum wallboard can resonate somewhat like the skin of a 58 59 drum and actually reduce the STC rating of the assembly as reflected by Equations 3 and 4 and 60 Commentary Table 7.3-5. When gypsum wallboard is 61 attached directly to the surface of coarse-textured 62 concrete masonry, it provides the same benefit for 63 64 sound transmission loss as for sealing the surface but 65 provides no additional benefit due to its mass (ref. 7). 66

# 5 — Materials

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No commentary.

### 6 — Construction

# 6.1 Sealing penetrations and joints

Noncompressible materials, including mortar and grout, should not be used for fillers for expansion joints and the top of nonloadbearing partition walls. Where roof or floor construction is metal deck, use special shape foam filler strips to seal the top of the assembly.

The type and shape of penetrations and joints may greatly affect the sound transmission loss of an assembly. (See Figure 6.2.1 for common examples.) This variation is difficult to quantity and so sealing all penetrations, joints, and other holes, cracks or voids not otherwise specified with the appropriate sealant is of utmost importance (see Figure 6.2.2).

To act as an effective sound barrier, partitions should be carried to the underside of the floor or roof. The joint between the underside of a floor or roof and top of a partition should provide for slab deflection and be sealed against sound transmission. Fire-rated assemblies are also required to meet fire resistive construction requirements including fire stopping of through penetrations and fire-resistive sealing materials in accordance with the legally-adopted building code. Fire safety provisions of the legally adopted building code may limit the type(s) of material(s) permitted to be used in joints of fire rated construction.

If roof or floor construction is metal deck rather than concrete, it is not feasible to use joint sealants alone to seal the top of masonry assemblies because of the shape of the deck flutes. For fire

- 1 and smoke containment assemblies, safing
- 2 insulation is used instead of foam filler strips. 4

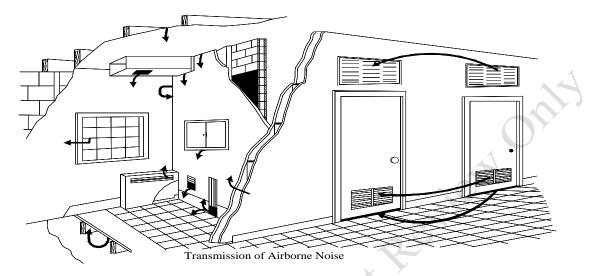


Figure 6.2.1 — Acoustical Leaks (Ref. 1)

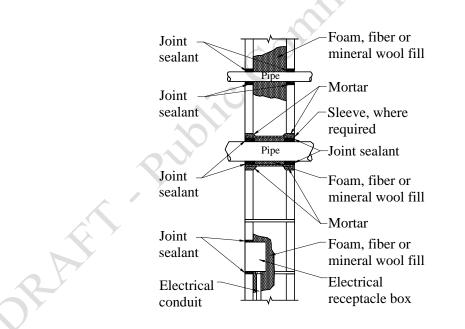


Figure 6.2.2 — Sealing Around Penetrations and Fixtures

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### 6.2 Surface coatings

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2 Assemblies constructed of fine and medium 3 textured concrete masonry units and fired clay 4 masonry assemblies do not require additional 5 treatments, however, assemblies surface 6 constructed using coarse textured concrete 7 masonry units, which may allow airborne sound to 8 enter the assembly, require a surface treatment to 9 seal at least one surface of the assembly. Coatings 10 of acrylic latex, alkyd or cement-based paint, or of plaster are acceptable. Other coatings are also 11 12 acceptable provided they effectively seal the surface of coarse textured concrete masonry units. 13

14 There is substantial discussion about the 15 effect of porosity of concrete masonry units in 16 Reference 7. This reference included both 17 lightweight aggregate and what was termed very 18 porous (wood aggregate) blocks in their study for 19 the purposes of comparison. The report indicated 20 that leakage of sound was somewhat related to the 21 airflow resistivity of the units and that sealing of 22 coarse-textured units on only one surface was 23 effective. Normal weight blocks showed little or 24 no improvement in sound transmission resistivity 25 after sealing. Texture as used in this context does not refer to the surface roughness of the block but 26 27 the matrix of the mix used in manufacturing the 28 block.

29 The committee reasoned that, in most cases, 30 sound rated assemblies with coarse-textured units 31 would have a surface treatment on at least one 32 surface, which is subsequently required by 33 Section 6.2. Therefore, the data for unsealed 34 coarse-textured masonry units was not included in 35 developing the concrete masonry equations for 36 calculated sound transmission ratings. RAFT 37

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#### 39 7 — Sound Transmission Class Ratings

### 7.1 Laboratory testing

Representative masonry materials need not be from the same manufacturer.

### 7.2 Field testing

No commentary.

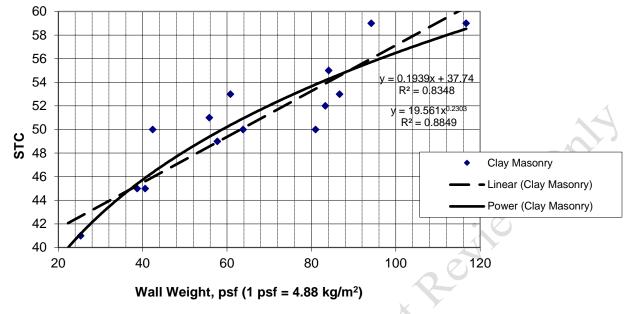
## 7.3 Calculation

#### 7.3.1 Clay Masonry Construction

Sound transmission class, STC, data of clay masonry assemblies (Ref. 2) are plotted against average assembly weight, W, in Figure 7.3-1. The equation for the curve best fitting the data is STC  $= 19.6W^{0.230}$  (STC = 13.6W  $^{0.230}$ ) with a correlation coefficient of 0.885. Figure 7.3-1 also shows that a power curve fit is better than a linear fit of the data. Table 7.3-1 lists the reported STC values of the various clay masonry assemblies tested. Table 7.3-3 lists various calculated STC values for clay masonry assemblies.

### 7.3.2 Concrete Masonry Construction

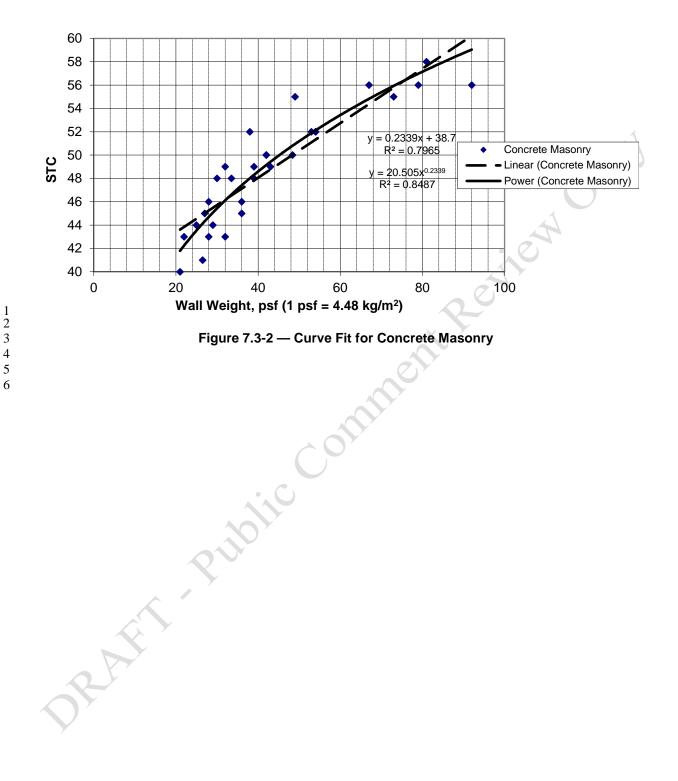
STC data of concrete masonry assemblies (Ref. 3, 4, 5, and 6) are plotted against average assembly weight, W, in Figure 7.3-2. The equation for the curve best fitting the data is STC  $= 20.5W^{0.234}(STC = 14.1W^{0.234})$  with a correlation coefficient of 0.849. Figure 7.3-2 also shows that a power curve fit is better than a linear fit of the data. Table 7.3-2 lists the reported STC values of the various clay masonry assemblies tested. Table 7.3-4 lists various calculated STC values for concrete masonry assemblies.



# Figure 7.3-1 — Curve Fit for Clay Masonry

		of Clay Masolity (Ref. 2)
	Weight psf, (kg/m <sup>2</sup> )	Reported STC
	22.3 (109)	39
	25.3 (124)	41
	38.7 (189)	45
	40.6 (198)	45
	42.4 (207)	50
	55.8 (272)	51
	57.7 (282)	49
	60.8 (297)	53
	63.8 (311)	50
	81 (395)	50
	83.3 (407)	52
	84.1 (411)	55
<b>N</b> Y	86.7 (423)	53
$\mathbf{V}$	94.2 (460)	59
*	116.7 (570)	59

# Table 7.3-1 — Data for Clay Masonry (Ref. 2)



Weight ClassFinishpsf. $(kg/m^2)$ STCReferenceLightweightBare21 (103)40Ref. 4LightweightBare25 (122)44Ref. 4LightweightBare36 (176)45Ref. 4LightweightBare39 (190)49Ref. 4LightweightBare43 (210)49Ref. 4LightweightPaint22 (107)43Ref. 4LightweightPaint22 (107)43Ref. 4LightweightPaint22 (107)46Ref. 4LightweightPaint23 (156)43Ref. 3LightweightPaint32 (156)43Ref. 3LightweightPaint73 (356)55Ref. 4LightweightPlaster38 (186)52Ref. 4LightweightPlaster32 (156)49Ref. 4LightweightPlaster32 (156)49Ref. 4LightweightPlaster30 (146)48Ref. 4LightweightPlaster32 (156)49Ref. 4LightweightPlaster49 (239)55Ref. 4LightweightPlaster54 (264)52Ref. 4LightweightPlaster79 (386)56Ref. 4LightweightPlaster79 (386)56Ref. 4LightweightPlaster79 (386)56Ref. 4LightweightPlaster81 (395)58Ref. 4LightweightP				Weight			
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# Table 7.3-2— Data for Concrete Masonry (Ref. 3, 4, 5, & 6)

Nominal Assembly Thickness <sup>2</sup> in. (mm)	Hollow U	Units	Grout Filled		Sand Filled		Solid Units		
	Weight psf, (kg/m <sup>2</sup> )	STC	Weight psf, (kg/m <sup>2</sup> )	STC	Weight psf, (kg/m <sup>2</sup> )	STC	Weight psf, (kg/m <sup>2</sup> )	STC	
3 (75)	Not applica	ble	Not applicable		Not applicable		30 (146) 4		
4 (100)	20 (98)	39	38 (186)	45	32 (156)	43	35 (171)	44	
6 (150)	32 (156)	43	63 (308)	51	50 (244)	48	55 (269)	49	
8 (200)	42 (205)	46	86 (420)	55	68 (332)	52	75 (366)	53	
10 (250)	53 (259)	49	109 (532)	58	86 (420)	55	95 (464)	56	
12 (300)	62 (303)	51	132 (644)	60	104 (508)	57	115 (561)	58	

# Table 7.3-3 — Calculated STC Ratings for Clay Masonry Assemblies<sup>1</sup>

<sup>1</sup> Based on the smallest specified unit dimension minus the specified tolerance, Clay density of 120 lbs/ft<sup>3</sup>

4 (586 kg/m<sup>3</sup>); Grout density of 144 lbs/ft<sup>3</sup> (703 kg/m<sup>3</sup>), Sand density of 100 lbs/ft<sup>3</sup> (488 kg/m<sup>3</sup>). STC values for grout 5 filled and sand filled units assume the materials completely occupy all void areas in and around the units. STC

6 7 values for solid units are based on bed and head joints solidly filled with mortar.

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<sup>2</sup> Dimensions in this column reflect equivalent nominal metric unit sizes as opposed to direct SI conversion.

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# Table 7.3-4—Calculated STC Values for Concrete Masonry Assemblies<sup>1</sup>

Nominal	Density pcf			<u>rc</u>	-		Nominal	Density pcf			<u>rc</u>	-
Unit Size <sup>2</sup>	(kg/m <sup>3</sup> )	Hollow	Grout	Sand Filled	Solid Units		Unit Size <sup>2</sup>	(kg/m <sup>3</sup> )	Hollow	Grout	Sand Filled	Solid Units
in. (mm)		Unit	Filled	Sand I med	Solid Clifts		in. (mm)		Unit	Filled	Sand I med	Solid Olins
4 (100)	80 (1281)	40	45	43	43		4 (100)	85 (1362)	40	45	44	44
6 (150)	80 (1281)	41	51	48	48		6 (150)	85 (1362)	42	51	48	48
8 (200)	80 (1281)	44	54	51	51		8 (200)	85 (1362)	44	55	52	52
10 (250)	80 (1281)	46	58	54	54		10 (250)	85 (1362)	46	58	55	55
12 (300)	80 (1281)	47	60	57	56		12 (300)	85 (1362)	48	61	57	57
Nominal	Density pcf		ST	ГC			Nominal	Density pcf		ST	TC .	
Unit Size <sup>2</sup>	$(kg/m^3)$	Hollow	Grout	a 1591 1	0.1111.1		Unit Size <sup>2</sup>	$(kg/m^3)$	Hollow	Grout	G 1 1711 1	a PLUE
in. (mm)	(8,,	Unit	Filled	Sand Filled	Solid Units		in. (mm)	(	Unit	Filled	Sand Filled	Solid Units
4 (100)	90 (1442)	41	45	44	44		4 (100)	95 (1522)	41	46	44	45
6 (150)	90 (1442)	42	51	49	49		6 (150)	95 (1522)	43	51	49	49
8 (200)	90 (1442)	45	55	52	52		8 (200)	95 (1522)	45	55	52	53
10 (250)	90 (1442)	47	58	55	55		10 (250)	95 (1522)	48	58	55	56
12 (300)	90 (1442)	48	61	57	58		12 (300)	95 (1522)	49	61	58	58
12 (500)	)0 (1 <del>11</del> 2)	-10	01	51	50	I I	12 (500)	<i>)3</i> (1 <i>322</i> )		01	50	50
Nominal	Density pcf		ST	TC		1	Nominal	Density pcf		ST	rc	
Unit Size <sup>2</sup>	(kg/m <sup>3</sup> )	Hollow	Grout				Unit Size <sup>2</sup>	(kg/m <sup>3</sup> )	Hollow	Grout		
in. (mm)	(kg/m)		Filled	Sand Filled	Solid Units		in. (mm)	(kg/m)		Filled	Sand Filled	Solid Units
4 (100)	100 (1602)	Unit 42	46	45	45		4 (100)	105 (1682)	Unit 42	46	45	46
6 (150)	100(1002) 100(1602)	42	52	49	50		6 (150)	105 (1082)	44	52	50	50
8 (200)	100(1002) 100(1602)	45	56	53	54		8 (200)	105 (1082)	44	56	53	54
										59		
10 (250)	100 (1602)	48 49	59	56	56 59		10 (250)	105 (1682)	<u>49</u> 50	62	56	57
12 (300)	100 (1602)	49	61	58	59		12 (300)	105 (1682)	-50	02	58	60
Manala al	<b>D</b> : c		C7	r <i>C</i>		r r	Manalaal	<b>D</b> : c		C7	r <i>C</i>	
Nominal	Density pcf	Hollow	Grout	rC			Nominal	Density pcf	Hollow	Grout	rC	1
Unit Size <sup>2</sup>	(kg/m <sup>3</sup> )			Sand Filled	Solid Units		Unit Size <sup>2</sup>	(kg/m <sup>3</sup> )			Sand Filled	Solid Units
in. (mm)	110 (15(0)	Unit	Filled	15	16		in. (mm)	115 (10.10)	Unit	Filled	16	16
4 (100)	110 (1762)	43	47	45	46		4 (100)	115 (1842)	43	47	46	46
6 (150)	110 (1762)	44	52	50	51		6 (150)	115 (1842)	45	52	50	51
8 (200)	110 (1762)	47	56	53	55		8 (200)	115 (1842)	47	56	54	55
10 (250)	110 (1762)	49	59	56	58		10 (250)	115 (1842)	50	59	57	58
12 (300)	110 (1762)	51	62	59	60		12 (300)	115 (1842)	51	62	59	61
		0										
Nominal	Density pcf		ST	IC			Nominal	Density pcf		ST	TC	
Unit Size <sup>2</sup>	(kg/m <sup>3</sup> )	Hollow	Grout	Sand Filled	Solid Units		Unit Size <sup>2</sup>	(kg/m <sup>3</sup> )	Hollow	Grout	Sand Filled	Solid Units
in. (mm)		Unit	Filled			<b>Y</b>	in. (mm)		Unit	Filled		
4 (100)	120 (1922)	43	47	46	47		4 (100)	125 (2002)	44	48	46	47
6 (150)	120 (1922)	45	53	50	52		6 (150)	125 (2002)	45	53	51	52
8 (200)	120 (1922)	48	57	54	56		8 (200)	125 (2002)	48	57	54	56
10 (250)	120 (1922)	50	60	57	59		10 (250)	125 (2002)	50			
12 (300)									50	60	57	59
	120 (1922)	52	62	59	61		12 (300)	125 (2002)	52	60 63	57 60	59 62
	120 (1922)		62		61		12 (300)			63	60	
Nominal	Density pcf	52	62 <i>ST</i>	59 TC	61		12 (300) Nominal		52	63 <i>ST</i>		
Nominal Unit Size <sup>2</sup>	· · · ·		62	rc			12 (300)	125 (2002)		63	60 FC	62
Unit Size <sup>2</sup> in. (mm)	Density pcf (kg/m <sup>3</sup> )	52 Hollow Unit	62 S7 Grout Filled	C Sand Filled	Solid Units		12 (300) Nominal	125 (2002) Density pcf (kg/m <sup>3</sup> )	52 Hollow Unit	63 S7 Grout Filled	60 FC Sand Filled	62 Solid Units
Unit Size <sup>2</sup> in. (mm) 4 (100)	Density pcf (kg/m <sup>3</sup> ) 130 (2082)	52 Hollow Unit 44	62 Grout Filled 48	C Sand Filled 47	Solid Units 48		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100)	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162)	52 Hollow Unit 45	63 Grout Filled 48	60 FC Sand Filled 47	62 Solid Units 48
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150)	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082)	52 Hollow Unit 44 46	62 Grout Filled 48 53	C Sand Filled 47 51	Solid Units 48 53		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150)	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162)	52 Hollow Unit 45 46	63 Grout Filled 48 53	60 FC Sand Filled 47 51	62 Solid Units 48 53
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200)	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082)	52 Hollow Unit 44 46 49	62 Grout Filled 48 53 57	C Sand Filled 47 51 55	Solid Units 48 53 57		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200)	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162)	52 Hollow Unit 45 46 49	63 57 Grout Filled 48 53 57	60 FC Sand Filled 47 51 55	62 Solid Units 48 53 57
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250)	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082)	52 Hollow Unit 44 46 49 51	62 Grout Filled 48 53 57 60	C Sand Filled 47 51 55 57	Solid Units 48 53 57 60		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250)	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162)	52 Hollow Unit 45 46 49 51	63 Grout Filled 48 53 57 60	60 FC Sand Filled 47 51 55 58	62 Solid Units 48 53 57 60
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200)	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082)	52 Hollow Unit 44 46 49	62 Grout Filled 48 53 57	C Sand Filled 47 51 55	Solid Units 48 53 57		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200)	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162)	52 Hollow Unit 45 46 49	63 57 Grout Filled 48 53 57	60 FC Sand Filled 47 51 55	62 Solid Units 48 53 57
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250)	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082)	52 Hollow Unit 44 46 49 51	62 Grout Filled 48 53 57 60	C Sand Filled 47 51 55 57	Solid Units 48 53 57 60		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250)	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162) 135 (2162)	52 Hollow Unit 45 46 49 51	63 Grout Filled 48 53 57 60	60 FC Sand Filled 47 51 55 58	62 Solid Units 48 53 57 60
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250)	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082)	52 Hollow Unit 44 46 49 51	62 S7 Grout Filled 48 53 57 60 63	C Sand Filled 47 51 55 57	Solid Units 48 53 57 60		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250)	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162)	52 Hollow Unit 45 46 49 51	63 Grout Filled 48 53 57 60	60 <i>FC</i> Sand Filled 47 51 55 58 60	62 Solid Units 48 53 57 60
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) Density pcf	52 Hollow Unit 44 46 49 51	62 S7 Grout Filled 48 53 57 60 63	<i>FC</i> Sand Filled 47 51 55 57 60	Solid Units 48 53 57 60 62		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) Density pcf	52 Hollow Unit 45 46 49 51	63 Grout Filled 48 53 57 60 63	60 <i>FC</i> Sand Filled 47 51 55 58 60 <i>FC</i>	62 Solid Units 48 53 57 60 63
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup>	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082)	52 Hollow 44 46 49 51 52 Hollow	62 Grout Filled 48 53 57 60 63 63 Grout	C Sand Filled 47 51 55 57 60	Solid Units 48 53 57 60 62		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup>	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162)	52 Hollow 45 46 49 51 53 Hollow	63 Grout Filled 48 53 57 60 63 63 <i>ST</i> Grout	60 <i>FC</i> Sand Filled 47 51 55 58 60 <i>FC</i>	62 Solid Units 48 53 57 60
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm)	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) Density pcf (kg/m <sup>3</sup> )	52 Hollow Unit 44 46 49 51 52 Hollow Unit	62 S7 Grout Filled 48 53 57 60 63 S7 Grout Filled	C Sand Filled 47 51 55 57 60 C Sand Filled	Solid Units 48 53 57 60 62 Solid Units		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm)	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) Density pcf (kg/m <sup>3</sup> )	52 Hollow 45 46 49 51 53 Hollow Unit	63 Grout Filled 48 53 57 60 63 Grout Filled	60 <i>FC</i> Sand Filled 47 51 55 58 60 <i>FC</i> Sand Filled	62 Solid Units 48 53 57 60 63 Solid Units
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100)	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 140 (2243)	52 Hollow Unit 44 46 49 51 52 52 Hollow Unit 45	62 Grout Filled 48 53 57 60 63 63 Grout Filled 48	<i>FC</i> Sand Filled 47 51 55 57 60 <i>FC</i> Sand Filled 47	Solid Units 48 53 57 60 62 Solid Units 48		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100)	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) Density pcf (kg/m <sup>3</sup> ) 145 (2323)	52 Hollow Unit 45 46 49 51 53 53 Hollow Unit 45	63 Grout Filled 48 53 57 60 63 63 Grout Filled 49	60 <i>FC</i> Sand Filled 47 51 55 58 60 <i>FC</i> Sand Filled 48	62 Solid Units 48 53 57 60 63 63 Solid Units 49
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Vominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150)	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) Density pcf (kg/m <sup>3</sup> ) 140 (2243) 140 (2243)	52 Hollow 44 46 49 51 52 Hollow Unit 45 46	62 S7 Grout Filled 48 53 57 60 63 S7 Grout Filled 48 54	<i>FC</i> Sand Filled 47 51 55 57 60 <i>FC</i> Sand Filled 47 51	Solid Units 48 53 57 60 62 Solid Units 48 54		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150)	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) Density pcf (kg/m <sup>3</sup> ) 145 (2323) 145 (2323)	52 Hollow 45 46 49 51 53 Hollow Unit 45 47	63 S7 Grout Filled 48 53 57 60 63 S7 Grout Filled 49 54	60 Sand Filled 47 51 55 58 60 <i>CC</i> Sand Filled 48 52	62 Solid Units 48 53 57 60 63 Solid Units 49 54
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200)	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) Density pcf (kg/m <sup>3</sup> ) 140 (2243) 140 (2243)	52 Hollow Unit 44 49 51 52 Hollow Unit 45 46 49	62 S7 Grout Filled 48 53 57 60 63 S7 60 63 S7 Grout Filled 48 54 54 58	<i>FC</i> Sand Filled 47 51 55 57 60 <i>FC</i> Sand Filled 47 51 55	Solid Units 48 53 57 60 62 Solid Units 48 54 57		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 6 (150) 8 (200)	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) Density pcf (kg/m <sup>3</sup> ) 145 (2323) 145 (2323)	52 Hollow 45 46 49 51 53 Hollow Unit 45 47 50	63 S7 Grout Filled 48 53 57 60 63 Grout Filled 49 54 58	60 <i>FC</i> Sand Filled 47 51 55 58 60 <i>FC</i> Sand Filled 48 52 55	62 Solid Units 48 53 57 60 63 Solid Units 49 54 58
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250)	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) Density pcf (kg/m <sup>3</sup> ) 140 (2243) 140 (2243) 140 (2243)	52 Hollow Unit 44 49 51 52 Hollow Unit 45 46 49 52	62 S7 Grout Filled 48 53 57 60 63 S7 60 63 S7 Grout Filled 48 54 54 54 54 61	C           Sand Filled           47           51           55           57           60           C           Sand Filled           47           51           57           60           55           58	Solid Units 48 53 57 60 62 Solid Units 48 54 57 61		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250)	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) Density pcf (kg/m <sup>3</sup> ) 145 (2323) 145 (2323) 145 (2323)	52 Hollow 45 46 49 51 53 Hollow Unit 45 47 50 52	63 S7 Grout Filled 48 53 57 60 63 S7 Grout Filled 49 54 58 61	60 FC Sand Filled 47 51 55 58 60 FC Sand Filled 48 52 55 58 58	62 Solid Units 48 53 57 60 63 Solid Units 49 54 54 58 61
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200)	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) Density pcf (kg/m <sup>3</sup> ) 140 (2243) 140 (2243)	52 Hollow Unit 44 49 51 52 Hollow Unit 45 46 49	62 S7 Grout Filled 48 53 57 60 63 S7 60 63 S7 Grout Filled 48 54 54 58	<i>FC</i> Sand Filled 47 51 55 57 60 <i>FC</i> Sand Filled 47 51 55	Solid Units 48 53 57 60 62 Solid Units 48 54 57		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300)	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) Density pcf (kg/m <sup>3</sup> ) 145 (2323) 145 (2323) 145 (2323) 145 (2323)	52 Hollow 45 46 49 51 53 Hollow Unit 45 47 50 52 54	63 S7 Grout Filled 48 53 57 60 63 S7 Grout Filled 49 54 58 61 64	60 FC Sand Filled 47 51 55 58 60 FC Sand Filled 48 52 55 58 61	62 Solid Units 48 53 57 60 63 Solid Units 49 54 58 61 64
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Wominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300)	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) Density pcf (kg/m <sup>3</sup> ) 140 (2243) 140 (2243) 140 (2243) 140 (2243)	52 Hollow Unit 44 49 51 52 Hollow Unit 45 46 49 52	62 S7 Grout Filled 48 53 57 60 63 S7 Grout Filled 48 54 54 58 61 63	<i>FC</i> Sand Filled 47 51 55 57 60 <i>FC</i> Sand Filled 47 51 55 58 60	Solid Units 48 53 57 60 62 Solid Units 48 54 57 61		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 10 (250) 11 (300) 12 (300) 14 (300) 15 (300) 15 (300) 16 (300) 17 (300) 18 (300) 18 (300) 18 (300) 18 (300) 18 (300) 18 (300) 19 (300) 10 (30	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 145 (2323) 145 (232) 145	52 Hollow 45 46 49 51 53 53 Hollow Unit 45 47 50 52 52 54 40 lb/ft³(224	63 S7 Grout Filled 48 53 57 60 63 Grout Filled 49 54 58 61 61 64 83 kg/m <sup>3</sup> ), sand	60 <i>FC</i> Sand Filled 47 51 55 58 60 <i>FC</i> Sand Filled 48 52 55 58 61 Idensity of 90	62 Solid Units 48 53 57 60 63 Solid Units 49 54 58 61 64 Ib/ft <sup>3</sup>
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) 7 Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 140 (2243) 140 (2243) 140 (2243) 140 (2243)	52 Hollow Unit 44 49 51 52 Hollow Unit 45 46 49 52 53	62 S7 Grout Filled 48 53 57 60 63 Grout Filled 48 54 54 58 61 63 S7 S7 S7 S7 S7 S7 S7 S7 S7 S7	C           Sand Filled           47           51           55           57           60           CC           Sand Filled           47           51           57           60           CC           Sand Filled           47           51           58           60           CC	Solid Units 48 53 57 60 62 Solid Units 48 54 57 61 63		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 11 (300) 12 (300) 13 (300) 14 2 kg/m <sup>3</sup> )	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) Density pcf (kg/m <sup>3</sup> ) 145 (2323) 145 (232) 145	52 Hollow 45 46 49 51 53 Hollow Unit 45 47 50 52 54 40 lb/ft <sup>3</sup> (224 c of 130 lb/ft <sup>3</sup>	63 S7 Grout Filled 48 53 57 60 63 Grout Filled 49 54 58 61 64 31 kg/m <sup>3</sup> ), sand (2082 kg/m <sup>3</sup> ), sand	60 <i>FC</i> Sand Filled 47 51 55 58 60 <i>FC</i> Sand Filled 48 52 55 58 61 density of 90 Percentage so	62 Solid Units 48 53 57 60 63 Solid Units 49 54 58 61 64 1b/ft <sup>3</sup> olid of units
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup>	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) Density pcf (kg/m <sup>3</sup> ) 140 (2243) 140 (2243) 140 (2243) 140 (2243)	52 Hollow Unit 44 49 51 52 Hollow Unit 45 46 49 52 53 Hollow	62 S7 Grout Filled 48 53 57 60 63 Grout Filled 48 54 54 54 54 54 61 63 S7 Grout S7 Grout Filled 57 60 63 S7 60 54 54 55 57 60 57 57 60 57 57 60 57 57 60 57 57 60 57 57 60 57 57 60 57 57 60 57 57 60 57 57 60 53 57 60 57 57 60 57 57 60 57 57 60 57 57 60 57 57 60 57 57 57 57 60 57 57 57 60 57 57 57 57 57 57 57 57 57 57	C           Sand Filled           47           51           55           57           60           CC           Sand Filled           47           51           57           60           CC           Sand Filled           47           51           58           60           CC	Solid Units 48 53 57 60 62 Solid Units 48 54 57 61		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 11 (300) <sup>1</sup> Based on gr (1442 kg/m <sup>3</sup> ) used from m	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 145 (2323) 145 (232) 145	52 Hollow 45 46 49 51 53 Hollow Unit 45 47 50 52 54 40 lb/ft <sup>3</sup> (224 yof 130 lb/ft <sup>3</sup> )	63 S7 Grout Filled 48 53 57 60 63 Grout Filled 49 54 58 61 64 3kg(m <sup>3</sup> ), sanc (2082 kg/m <sup>3</sup> ), fortypical ma	60           Sand Filled           47           51           55           58           60 <i>TC</i> Sand Filled           48           52           55           58           61           Idensity of 90           Percentage se sonry units 4 i	62 Solid Units 48 53 57 60 63 Solid Units 49 54 58 61 64 Ib/ft <sup>3</sup> olid of units n. (100
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Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Wominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100)	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) Density pcf (kg/m <sup>3</sup> ) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 140 (2243)	52 Hollow Unit 44 49 51 52 Hollow Unit 45 46 49 52 53 53 Hollow Unit 46	62 S7 Grout Filled 48 53 57 60 63 S7 60 63 S7 Grout Filled 48 54 58 61 63 S7 Grout Filled 48 S7 60 63 S7 Grout Filled 48 S7 60 63 S7 57 60 63 S7 60 63 S7 58 61 63 S7 57 60 63 S7 58 61 63 S7 60 63 S7 58 61 63 S7 57 60 63 S7 58 61 63 S7 57 63 S7 57 58 61 63 S7 57 57 57 60 63 S7 57 58 61 63 S7 57 57 57 58 57 57 57 57 57 57 57 57 57 57	FC           Sand Filled           47           51           55           57           60           FC           Sand Filled           47           51           57           60           FC           Sand Filled           47           51           58           60           FC           Sand Filled           48	Solid Units 48 53 57 60 62 Solid Units 48 54 57 61 63 Solid Units 49		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (220) 10 (250) <sup>1</sup> Based on gr (1442 kg/m <sup>3</sup> ) used from m mm) (73.8%	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 145 (2323) 145 (2	52 Hollow Unit 45 46 49 51 53 Hollow Unit 45 47 50 52 54 40 lb/ft <sup>3</sup> (224 v of 130 lb/ft <sup>3</sup> ) (224 v of 130 lb/ft <sup>3</sup> )	63 S7 Grout Filled 48 53 57 60 63 60 63 S7 Grout Filled 49 54 58 61 64 3 kg/m <sup>3</sup> ), sanc (2082 kg/m <sup>3</sup> ), sanc (2	60 <i>C</i> Sand Filled 47 51 55 58 60 <i>C</i> Sand Filled 48 52 55 58 61 Idensity of 90 Percentage si sonry units 4 i (200 mm) (53). <i>STC</i>	62 Solid Units 48 53 57 60 63 Solid Units 49 54 58 61 64 1b/ft <sup>3</sup> olid of units n. (100 0% solid); ralues for
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) 7 Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) 7 Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150)	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 150 (2403) 150 (2403)	52 Hollow Unit 44 49 51 52 Hollow Unit 45 46 49 52 53 Hollow Unit 46 47	62 S7 Grout Filled 48 53 57 60 63 S7 Grout Filled 48 54 58 61 63 S7 Grout Filled 48 54 58 61 63 S7 57 58 60 57 58 51 54 58 57 58 57 58 57 58 57 58 57 58 57 58 57 58 57 58 57 58 57 58 57 58 57 58 57 58 57 58 57 58 57 58 58 57 58 58 57 58 58 57 58 58 57 58 58 57 58 58 57 57 58 57 58 57 57 58 57 57 58 57 57 58 57 57 58 57 57 58 57 57 58 57 57 57 57 57 58 57 57 57 57 57 58 57 57 57 57 57 58 57 57 57 57 57 57 57 57 57 57	FC           Sand Filled           47           51           55           57           60           FC           Sand Filled           47           51           55           58           60           FC           Sand Filled           47           51           58           60           FC           Sand Filled           48           52	Solid Units 48 53 57 60 62 Solid Units 48 54 57 61 63 Solid Units 49 54		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 10 (250) 11 (300) <sup>1</sup> Based on gr (1442 kg/m <sup>3</sup> ) used from m mm) (73.8% 10 in. (250 r	125 (2002)           Density pcf (kg/m³)           135 (2162)           135 (2162)           135 (2162)           135 (2162)           135 (2162)           135 (2162)           135 (2162)           135 (2162)           135 (2162)           Density pcf (kg/m³)           145 (2323)           145 (2323)           145 (2323)           145 (2323)           145 (2323)           out density of 1           out density of 1           old manufacture           solid), 6 in. (15)           m)(51.7% soli	52 Hollow Unit 45 46 49 51 53 Hollow Unit 45 47 50 52 54 40 lb/ft <sup>3</sup> (224 v of 130 lb/ft <sup>3</sup> ) 55 54 (v of 130 lb/ft <sup>3</sup> ) 55 (v of 130 lb/ft <sup>3</sup> ) 55 (v of 130 lb/ft <sup>3</sup> ) (v	63 ST Grout Filled 48 53 57 60 63 Grout Filled 49 54 58 61 64 3 (g/m <sup>3</sup> ), sand (2082 kg/m <sup>3</sup> ), for typical ma 6 solid); 8 in 0 mm) (48.7% tem aterials cc	60           Sand Filled           47           51           55           58           60 <i>TC</i> Sand Filled           48           52           55           58           61           Idensity of 90           Percentage se sonry units 4 i (200 mm) (53. solid). <i>STC</i> (35. solid). <i>STC</i>	62 Solid Units 48 53 57 60 63 Solid Units 49 54 58 61 64 1b/ft <sup>3</sup> 0id of units n.(100 0% solid); /alues for py all void
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) 10 (250) 10	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 150 (2403) 150 (2403) 150 (2403)	52 Hollow Unit 44 49 51 52 Hollow Unit 45 46 49 52 53 Hollow Unit 46 49 52 53	62 S7 Grout Filled 48 53 57 60 63 S7 Grout Filled 48 54 54 55 61 63 S7 Grout Filled 48 54 54 54 55 54 55 54 55 54 55 54 55 54 55 54 55 55	C           Sand Filled           47           51           57           60           C           Sand Filled           47           51           55           58           60           CC           Sand Filled           47           51           55           58           60           CC           Sand Filled           48           52           56	Solid Units 48 53 57 60 62 Solid Units 48 54 57 61 63 Solid Units 49 54 58		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 6 (150) 10 (250) 11 (300) <sup>1</sup> Based on gr (1442 kg/m <sup>3</sup> ) used from mm mm) (73.8% 10 in. (250 m grout filled and areas in	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 145 (2323) 145 (232) 145	52 Hollow Unit 45 46 49 51 53 Hollow Unit 45 47 50 52 54 40 lb/ft <sup>3</sup> (224 70 f 130 lb/ft <sup>3</sup> (224 70 f 130 lb/ft <sup>3</sup> ) titrature 0 mm) (55.09 d); 12 in. (30 0 mits assume ti . STC values	63 ST Grout Filled 48 53 57 60 63 Grout Filled 49 54 58 61 64 3 (g/m <sup>3</sup> ), sand (2082 kg/m <sup>3</sup> ), for typical ma 6 solid); 8 in 0 mm) (48.7% tem aterials cc	60           Sand Filled           47           51           55           58           60 <i>TC</i> Sand Filled           48           52           55           58           61           Idensity of 90           Percentage se sonry units 4 i (200 mm) (53. solid). <i>STC</i> (35. solid). <i>STC</i>	62 Solid Units 48 53 57 60 63 Solid Units 49 54 58 61 64 1b/ft <sup>3</sup> 0id of units n.(100 0% solid); /alues for py all void
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250)	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 150 (2403) 150 (2403) 150 (2403)	52 Hollow Unit 44 49 51 52 Hollow Unit 45 46 49 52 53 Hollow Unit 46 47 50 53	62 S7 Grout Filled 48 53 57 60 63 58 61 63 57 58 61 63 54 54 54 54 54 55 61 63 54 54 54 54 54 54 55 61 63 55 61 63 55 61 63 55 61 63 55 61 63 55 61 63 55 61 63 55 61 63 55 61 63 55 61 61 63 55 61 61 63 55 61 61 63 55 61 61 61 61 61 61 61 61 61 61	C           Sand Filled           47           51           57           60           CC           Sand Filled           47           51           57           60           CC           Sand Filled           47           51           58           60           CC           Sand Filled           48           52           56           59	Solid Units 48 53 57 60 62 Solid Units 48 54 57 61 63 Solid Units 49 54 58 62		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) <sup>1</sup> Based on gr (1442 kg/m <sup>3</sup> ) used from mc mm) (73.8% 10 in. (250 nr grout filled and areas in and and head joints so	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 145 (2323) 145 (2	52 Hollow Unit 45 46 49 51 53 53 Hollow Unit 45 47 50 52 54 40 lb/ft <sup>3</sup> (224 70f 130 lb/ft <sup>3</sup> ) 754 40 lb/ft <sup>3</sup> (224 70f 130 lb/ft <sup>3</sup> ) 62 54 40 lb/ft <sup>3</sup> (224 70f 130 lb/ft <sup>3</sup> ) 75 70 mm) (55.00 0 mm) (55.00 0 mm) (55.00 0 mm) (55.00 10 m) (55.00 0 mm) (55.00 10 m) (55.00 0 m) (55.00 10 m) (55.00	63 S7 Grout Filled 48 53 57 60 63 60 63 S7 Grout Filled 49 54 58 61 64 3 kg/m <sup>3</sup> ), sand (2082 kg/m <sup>3</sup> ), sand (2	60           Sand Filled           47           51           55           58           60 <i>rC</i> Sand Filled           48           52           58           61           Idensity of 90           Percentage si sonry units 4 i (200 mm) (53)           solid). <i>STC</i> vmpktely occu is arebased on	62 Solid Units 48 53 57 60 63 Solid Units 49 54 58 61 64 Ib/ft <sup>3</sup> olid of units n. (100 .0% solid); ralues for rpy all void bed and
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) 10 (250) 10	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 130 (2082) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 150 (2403) 150 (2403) 150 (2403)	52 Hollow Unit 44 49 51 52 Hollow Unit 45 46 49 52 53 Hollow Unit 46 49 52 53	62 S7 Grout Filled 48 53 57 60 63 S7 Grout Filled 48 54 54 55 61 63 S7 Grout Filled 48 54 54 54 55 54 55 54 55 54 55 54 55 54 55 54 55 55	C           Sand Filled           47           51           57           60           C           Sand Filled           47           51           55           58           60           CC           Sand Filled           47           51           55           58           60           CC           Sand Filled           48           52           56	Solid Units 48 53 57 60 62 Solid Units 48 54 57 61 63 Solid Units 49 54 58		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 10 (250) 1 (300) <sup>1</sup> Based on gr (1442 kg/m <sup>3</sup> ) used from m mm) (73.8% 10 in. (250 n grout filled at areas in and a head joints so <sup>2</sup> Dimensions	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) Density pcf (kg/m <sup>3</sup> ) 145 (2323) 145 (2325) 145 (2	52 Hollow Unit 45 46 49 51 53 53 Hollow Unit 45 47 50 52 54 40 lb/ft <sup>3</sup> (224 70f 130 lb/ft <sup>3</sup> ) 754 40 lb/ft <sup>3</sup> (224 70f 130 lb/ft <sup>3</sup> ) 62 54 40 lb/ft <sup>3</sup> (224 70f 130 lb/ft <sup>3</sup> ) 75 70 mm) (55.00 0 mm) (55.00 0 mm) (55.00 0 mm) (55.00 10 m) (55.00 0 mm) (55.00 10 m) (55.00 0 m) (55.00 10 m) (55.00	63 S7 Grout Filled 48 53 57 60 63 60 63 S7 Grout Filled 49 54 58 61 64 3 kg/m <sup>3</sup> ), sand (2082 kg/m <sup>3</sup> ), sand (2	60 <i>C</i> Sand Filled 47 51 55 58 60 <i>C</i> Sand Filled 48 52 55 58 61 Idensity of 90 Percentage si sonry units 4 i (200 mm) (53) Solid). <i>STC</i> v mpktely occu s are based on	62 Solid Units 48 53 57 60 63 Solid Units 49 54 58 61 64 Ib/ft <sup>3</sup> olid of units n. (100 .0% solid); ralues for rpy all void bed and
Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250)	Density pcf (kg/m <sup>3</sup> ) 130 (2082) 130 (2082) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 140 (2243) 150 (2403) 150 (2403) 150 (2403)	52 Hollow Unit 44 49 51 52 Hollow Unit 45 46 49 52 53 Hollow Unit 46 47 50 53	62 S7 Grout Filled 48 53 57 60 63 58 61 63 57 58 61 63 54 54 54 54 54 55 61 63 54 54 54 54 54 54 55 61 63 55 61 63 55 61 63 55 61 63 55 61 63 55 61 63 55 61 63 55 61 63 55 61 63 55 61 61 63 55 61 61 63 55 61 61 63 55 61 61 61 61 61 61 61 61 61 61	C           Sand Filled           47           51           57           60           CC           Sand Filled           47           51           57           60           CC           Sand Filled           47           51           58           60           CC           Sand Filled           48           52           56           59	Solid Units 48 53 57 60 62 Solid Units 48 54 57 61 63 Solid Units 49 54 58 62		12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) Nominal Unit Size <sup>2</sup> in. (mm) 4 (100) 6 (150) 8 (200) 10 (250) 12 (300) <sup>1</sup> Based on gr (1442 kg/m <sup>3</sup> ) used from mc mm) (73.8% 10 in. (250 nr grout filled and areas in and and head joints so	125 (2002) Density pcf (kg/m <sup>3</sup> ) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) 135 (2162) Density pcf (kg/m <sup>3</sup> ) 145 (2323) 145 (2325) 145 (2	52 Hollow Unit 45 46 49 51 53 53 Hollow Unit 45 47 50 52 54 40 lb/ft <sup>3</sup> (224 70f 130 lb/ft <sup>3</sup> ) 754 40 lb/ft <sup>3</sup> (224 70f 130 lb/ft <sup>3</sup> ) 62 54 40 lb/ft <sup>3</sup> (224 70f 130 lb/ft <sup>3</sup> ) 75 70 mm) (55.00 0 mm) (55.00 0 mm) (55.00 0 mm) (55.00 10 m) (55.00 0 mm) (55.00 10 m) (55.00 0 m) (55.00 10 m) (55.00	63 S7 Grout Filled 48 53 57 60 63 60 63 S7 Grout Filled 49 54 58 61 64 3 kg/m <sup>3</sup> ), sand (2082 kg/m <sup>3</sup> ), sand (2	60 <i>C</i> Sand Filled 47 51 55 58 60 <i>C</i> Sand Filled 48 52 55 58 61 Idensity of 90 Percentage si sonry units 4 i (200 mm) (53) Solid). <i>STC</i> v mpktely occu s are based on	

# 7.3.2.1 Effect of Gypsum Wallboard on *STC* Ratings of Concrete Masonry Assemblies

The effect of gypsum wallboard attached directly to the surface of normal weight concrete masonry without a furring space has very little effect on the sound transmission class (*STC*) rating of the assembly. Gypsum wallboard directly attached to lightweight concrete masonry generally improves the *STC* rating by partially sealing of the surface. The more porous the masonry, the better the improvement in *STC* ratings. The amount of improvement is not quantifiable and therefore is not included in the calculated *STC* rating procedure. (Ref. 7 & 8).

Significant increases in *STC* ratings in a concrete masonry assembly can be achieved by adding gypsum wallboard and sound insulation in the furring space. Three factors govern the amount of improvement in *STC*:

- The method of support. The best method of support for the gypsum wallboard is the use of independent studs that have no direct connection to the concrete masonry. Resilient metal furring may also be used by itself or in combination with wood furring.
  - The depth of the furring space (distance between the gypsum wallboard and the concrete masonry surfaces).
  - The use of sound absorbing material in the furring space. (Ref. 7)

Mass-air-mass resonance at low frequencies and narrow furring spaces can cause the STC ratings to drop, particularly if that condition exists on both sides of the concrete masonry assembly. Under these conditions vibrational energy transfers from the gypsum board through the air space to the assembly more effectively than it does through the bare concrete masonry assembly. Table 7.3-5 presents the results of Eqs. 3 through 6 for various furring spaces with and without sound-absorbing material in the furring space.

Currently, there is no test data documenting the performance of gypsum wallboard over clay masonry assemblies. As such, the calculation procedures only address the impact of gypsum wallboard over concrete masonry assemblies.

## 7.3.3 Multi-Wythe Masonry Construction

The amount of acoustical testing on multiwythe assemblies containing wythes of concrete masonry and clay masonry is limited. Much higher *STC* values can be achieved by using materials other than wire ties to connect the two wythes, varying the cavity depth and the type of insulation used in the cavity (Ref. 6).

For multi-wythe walls constructed of both concrete masonry and clay masonry units, the determination of the STC requires the use of both Eq. 1 and Eq. 2 from Section 7.3 based on the total combined assembly weight and then linearly interpolating between the two calculated values based on the relative assembly weight of each material. For example, consider a masonry cavity wall with an 8 in. (203 mm) concrete masonry backup having an installed weight of 55 lb/ft<sup>2</sup> (269 kg/m<sup>2</sup>) and a 4 in. (102 mm) clay masonry veneer having an installed weight of 35 lb/ft<sup>2</sup> (171 kg/m<sup>2</sup>).

Total Assembly Weight =  $55 + 35 = 90 \text{ lb/ft}^2$ (439 kg/m<sup>2</sup>)

Calculated STC by Equation  $1 = (19.6)(90)^{0.230} = 55.2$ 

Calculated STC by Equation  $2 = (20.5)(90)^{0.234} = 58.8$ 

Linearly Interpolated STC Based on Relative Assembly Weight

= (55.2)(35/90) + (58.8)(55/90)= 21.5 + 35.9 = 57.4

# Table 7.3-5—Change in STC Using the Furring Space Depth Indicated and a Single Layer of Gypsum Wallboard

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Furring Space Condition	Sides			Furri	ng Space	, in. (m	m)		
		0.5	0.75	1.0	1.5	2.0	2.5	3.0	3.5
		(13)	(19)	(25)	(38)	(64)	(64)	(76)	(89)
No sound-absorbing material	One	0.2	0.9	1.6	3.0	4.4	5.8	7.2	8.6
in the furring space	Both	-1.0	-0.1	0.8	2.6	4.4	6.2	8.0	9.8
Furring space filled with	One	3.4	4.1	4.9	6.4	7.9	9.4	10.9	12.4
sound-absorbing material*	Both	-1.8	1.0	3.8	9.4	15.0	20.6	26.2	31.8

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re g in or sig. \*Fibrous materials, such as cellulose fiber, glass fiber or rock wool insulation, are good materials for absorbing sound; closed-cell materials, such as expanded polystyrene, are not, as they do not significantly absorb sound.

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# 1 8 — Outdoor-Indoor Transmission Class Ratings

8.1 Laboratory testing
Representative masonry materials need not
be from the same manufacturer.
8.2 Field testing
No commentary.

# 8.3 Calculation

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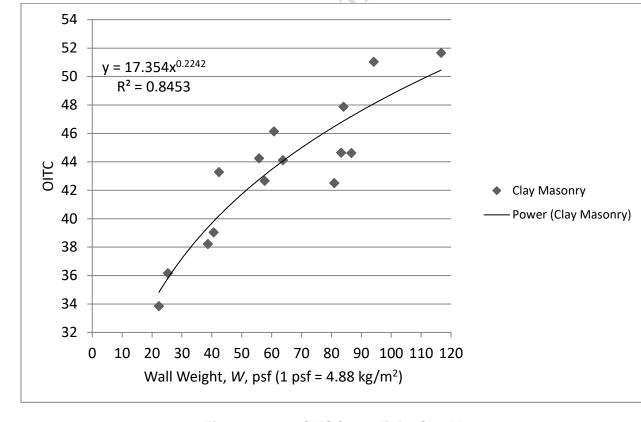
10 Many ASTM E90 sound transmission loss tests have been performed on a wide variety of 11 concrete masonry assemblies. Outdoor-Indoor 12 Transmission Class, OITC values for some of 13 14 these assemblies have been calculated in accordance with ASTM E1332 from E90 test 15 16 data, and are presented in Table 8.3-2. In general, 17 for masonry assemblies, heavier assemblies have 18 higher OITC values. Note that the ASTM E1332 19 OITC calculation requires transmission loss, STL, 20 test data from 80 Hz to 4,000 Hz, while ASTM E 21 90 test reports often do not include STL values at 22 80 Hz. Test reports that do include 80 Hz show 23 that the STL value of masonry assemblies at 80 Hz 24 is typically about the same or higher than that at 25 100 Hz. For the purposes of this Standard, where 50

*STL* values at 80 Hz were not reported, the 80 Hz *STL* was assumed equal to the 100 Hz *STL*.

*OITC* data of clay masonry assemblies (Ref. 2) are plotted against assembly weight, *W*, in Figure 8.3-1. The equation for the curve best fitting the data is *OITC* = 17.4  $W^{0.224}$  (*OITC* = 12.2  $W^{0.224}$ ) with a correlation coefficient of 0.8453.

*OITC* data of concrete masonry assemblies (Ref. 3, 4, 5, and 6) are plotted against average assembly weight, *W*, in Figure 8.3-2. The equation for the curve best fitting the data is  $OITC = 14.7W^{0.290}$  (*OITC* =  $9.28W^{0.290}$ ) with a correlation coefficient of 0.8024.

Section 8 does not include options for assessing the impact of gypsum wallboard on the calculated OITC rating of a masonry assembly. Given the lack of available research data, it is unknown as to whether the OITC values would increase, decrease, or remain unaffected by the presence of gypsum wallboard. Users should consider the relative benefits of adding gypsum wallboard to exterior walls when OITC is a design consideration.



# Figure 8.3-1 — OITC Curve Fit for Clay Masonry

# Table 8.3-1— OITC Data for Clay Masonry (Ref. 2)

Weight	ΟΙΤϹ
psf, (kg/m²)	
22.3 (109)	34
25.3 (124)	36
38.7 (189)	38
40.6 (198)	39
42.4 (207)	43
55.8 (272)	44
57.7 (282)	43
60.8 (297)	46
63.8 (311)	44
81 (395)	43
83.3 (407)	45
84.1 (411)	48
86.7 (423)	45
94.2 (460)	51
116.7 (570)	52

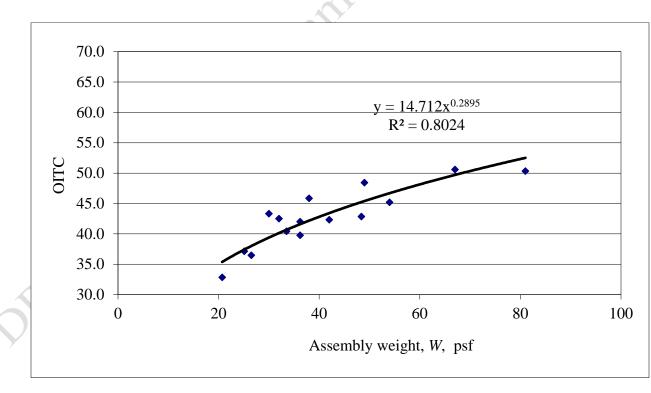


Figure 8.3-2 — OITC Curve Fit for Concrete Masonry

		Weight 2			
Weight Class*	Finish**	psf, (kg/m)	OITC	Reference	
L	0	20.7 (101)	32	Ref. 4	
Ν	1	26.5 (129)	36	Ref. 4	
Ν	2	32.0 (156)	42	Ref. 4	4
N	2	42.0 (205)	42	Ref. 4	
L	2	36.2 (177)	43	Ref. 4	
L	0	25.1 (123	37	Ref. 4	
L	2	54.0 (264)	45	Ref. 4	
L	0	36.2 (177)	39	Ref. 4	1
Ν	1	33.5 (164)	40	Ref. 4	A.
L	1	36.2 (177)	42	Ref. 4	0
Ν	0	48.4 (236)	42	Ref. 6	r
L	2	38.0 (186)	45	Ref. 4	
L	2	67.0 (327)	50	Ref. 4	
L	2	49.0 (239)	48	Ref. 4	
L	2	81.0 (395)	50	Ref. 4	

# Table 8.3-2— OITC Data for Concrete Masonry (Ref. 4 & 6)

\*Weight class L=Lightweight N=Normal weight \*\*Finish: 0=bare 1=paint 2=plaster

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# References

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