



Standard Guide for Design and Construction of Brick Liners for Industrial Chimneys¹

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1. Scope

1.1 This guide covers procedures for the design, construction, and serviceability of brick liners for industrial chimneys. The structural design criteria are applicable to vertical masonry cantilever structures supported only at their base, either by a foundation, a concrete pedestal, or by some means from the outer concrete shell. Excluded from direct consideration are single-wythe, sectional brick linings that are supported on a series of corbels cast in the outer chimney shell.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

C 395 Specification for Chemical-Resistant Resin Mortars²

C 466 Specification for Chemically Setting Silicate and Silica Chemical-Resistant Mortars²

C 980 Specification for Industrial Chimney Lining Brick²

E 447 Test Methods for Compressive Strength of Masonry Prisms²

E 111 Test Method for Young's Modulus, Tangent Modulus, and Chord Modulus³

2.2 ACI Standard:

307–88 Practice for the Design and Construction of Cast-In-Place Reinforced Concrete Chimneys⁴

2.3 ASCE Standard:

ASCE 7-88 Minimum Design Loads for Buildings and Other Structures (Formerly ANSI A58.1)

2.4 Other Standard:

1991 Uniform Building Code, International Conference of

Building Code Officials, California⁵

3. Terminology

3.1 Notations:

a	= brick dimension in radial direction (in.)
b	= brick dimension in tangential direction (in.)
c	= brick chamfer (in.)
C_e	= chimney deflection due to earthquake loads (in.)
d	= outside diameter of brick liner (in.)
D	= mean liner diameter at a given elevation (in.)
E_m	= masonry modulus of elasticity as established by performing brick prism test or by past experience, psi
f_b	= critical liner buckling stress, psi
f_d	= maximum vertical compressive stress due to dead load, psi
f_{de}	= maximum vertical compressive stress due to the combined effect of earthquake and dead load, psi
f_{dw}	= maximum vertical compressive stress due to the combined effect of wind and dead load, psi
f_m	= average ultimate masonry compressive strength established by performing brick prism test or by past experience, psi
f_v	= maximum shear stress due to wind or earthquake, psi
$F.S.$	= factor of safety
h	= total liner height (ft)
h_e	= height of liner above elevation being checked for buckling (ft)
L_e	= liner deflection due to earthquake loads (in.)
P	= constructional out-of-plumbness of liner with respect to shell (in.)
r	= average mean radius of liner (ft)
S	= shell deflection due to sun effect (in.)
T	= liner deflection due to differential temperature effects (in.)
t	= wall thickness (in.)
v	= coefficient of variation in brick prism tests
W	= shell deflection due to design wind loads (in.)
α	= coefficient of thermal expansion for brick liner (use 3.5×10^{-6} unless otherwise established) (in./in./°F)

4. Significance and Use

4.1 History:

4.1.1 For many years, brick liners have been used with an excellent record of performance. For the most part, however, the design and construction of brick liners has been based on past industry practice due to the lack of available information and knowledge of the physical properties of the brick and mortar, the thermal and seismic behavior of brick liners, and many related characteristics that were not properly or accurately defined.

4.1.2 The use of scrubbers, which lower gas temperatures and introduce highly corrosive condensates into the flue gas system, requires many new design considerations. The effect

¹ This guide is under the jurisdiction of ASTM Committee C-15 on Manufactured Masonry Units and is the direct responsibility of Subcommittee C15.09 on Chemical-Resistant Units.

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² Annual Book of ASTM Standards, Vol 04.05.

³ Annual Book of ASTM Standards, Vol 03.01.

⁴ Available from American Concrete Institute, P.O. Box 19150, Detroit, MI 48219.

⁵ Available from International Conference of Building Officials, 5360 South Workman Mill Road, Whittier, CA 90601.