fire protection planning report

BUILDING CONSTRUCTION INFORMATION FROM THE CONCRETE AND MASONRY INDUSTRIES

January 1995

Guide to 1994 Standard Building Code Requirements for Concrete and Masonry Fire Walls

Introduction

Properly designed and constructed fire walls provide an effective means of stopping the spread of fire. A generic definition of the term "fire wall" is "a wall of sufficient durability and stability to withstand the effects of the most severe anticipated fire exposure."[1] In addition, any openings or penetrations in the wall, if allowed, must be protected.

The *Standard Building Code* (hereafter referred to as SBC or "the code") recognizes areas separated by fire walls as being separate buildings. Insurance underwriters also acknowledge this by applying rates individually to each fire area where fire walls are constructed of concrete or masonry.

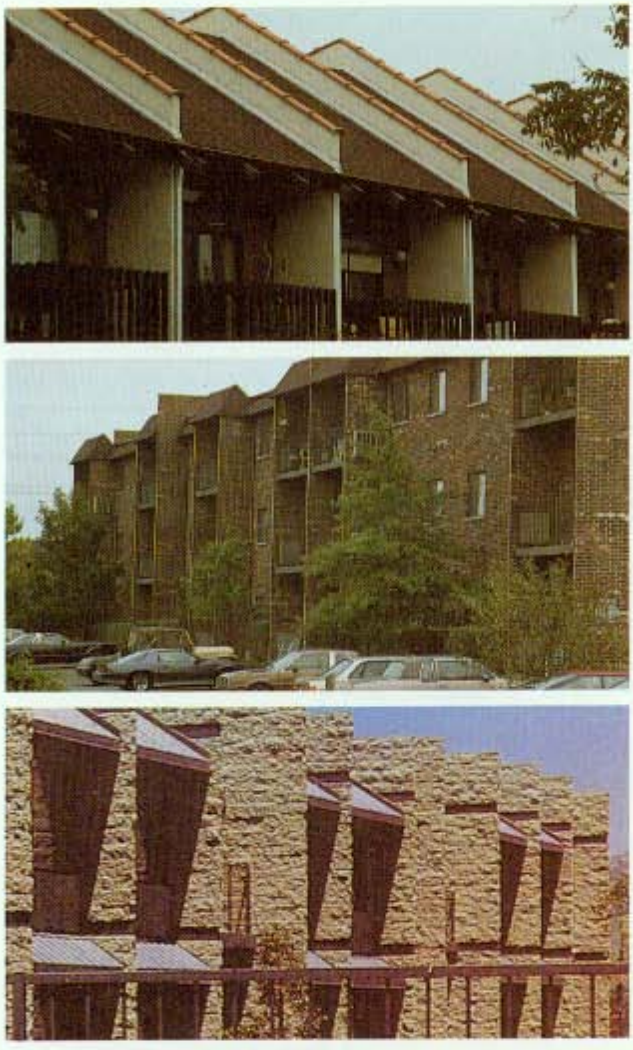
Fire walls must meet fire resistance rating requirements in accordance with ASTM E119 test procedures[2] as specified in Section 701.2 of the SBC.[3] In lieu of conducting fire tests, fire resistance ratings of concrete and masonry walls may be determined by calculation procedures contained in Section 709. Structural and other requirements of the code must also be considered in fire-wall design, but these are outside the scope of this report. The text that follows will focus on the fire-related provisions for concrete and masonry fire walls, based on the 1994 edition of the code.

Purpose

The purpose of this report is to provide building officials and the design community with supplemental information to the 1994 SBC regarding the code requirements for concrete and masonry fire walls.

The report contains:

1. The code's definition of a fire wall and characteristics common thereto,
2. Fire-rating requirements for fire walls and their components (parapets, opening protectives, penetration protection, etc.),
3. Conceptual drawings of wall-roof connections and restraining conditions necessary for fire walls to meet the code's stability criteria during a fire.



Concrete, clay-brick, and concrete masonry (top, middle, bottom) fire walls provide excellent barriers for containing the spread of fire from one side of the wall to another.

Common Characteristics of Fire Walls

In general, fire walls have the following characteristics:

1. For purposes of meeting allowable area requirements, areas divided by fire walls are considered as separate buildings.
2. The number of fire walls required in a structure is governed by area requirements that are based on occupancy and type of construction.
3. All openings in or penetrations of fire walls must be protected by appropriate fire-rated assemblies.

What Is a Fire Wall?

Section 202 of the SBC defines a fire wall as follows:

Fire wall—a 4 hour fire-resistant wall, having protective openings, which restricts the spread of fire and extends continuously from the foundation to or through the roof, with sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall. A fire wall on an interior lot line, used or adapted for joint service between two buildings, is called a party wall.

Fire-resistance Requirements

Except for townhouses, all fire walls are required to have a fire-endurance rating of four hours per Table 600 of the code. In townhouses not exceeding three stories, a two-hour rated wall separation is permitted, provided it meets the detailed criteria in Section 704.4 of the code.

In cases where two buildings of different heights are separated by a fire wall, the rating requirements for the fire wall only applies to that part of the wall up to the point where the fire wall terminates on the shorter of the two buildings. The part of the wall above the termination point is governed by exterior wall provisions. Since the fire wall, in effect, creates two separate buildings with an imaginary property line between them (see definition of horizontal separation in Section 202), the exterior wall portion must comply with Table 600 for zero horizontal separation distance. As such, no openings are permitted in the exterior wall. This wall arrangement is schematically shown in Fig. 1.

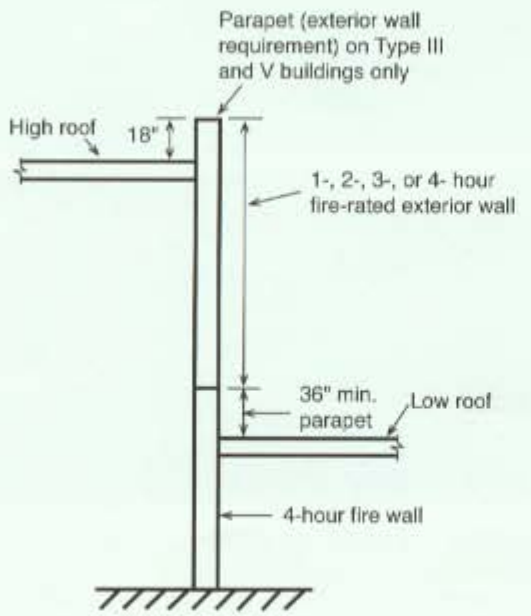


Fig. 1. SBC fire-wall requirements for unequal building heights.

As mentioned previously, fire-resistance ratings of concrete and masonry walls may be determined by calculation procedures contained in Section 709 of the code.

Where Are Fire Walls Required?

For new construction, area limitation provisions dictate the number of fire walls that a given structure will need. These requirements are a function of type of construction and occupancy and are provided in Table 500 of the code. Sections 503.2, 503.3, 503.4, and specific use provisions in Chapter 5 permit modifications to the table values.

Fire Wall Components

In designing fire walls, important aspects to consider are structural stability, fire resistance rating requirements, and the design and protection of integral wall components. Three of these components—parapets (and other wall extensions), openings, and penetrations, are discussed below.

Parapets and Wall Extensions

By definition, a parapet is that part of any wall entirely above the roof line (see photos, front page). As an extension of a fire wall, its function is to prevent the spread of fire across the roof from one building to another.

Section 704.5 requires parapets on party walls and fire walls to extend not less than three feet (914 mm) above the roof, with some exceptions. For example, in Types I, II, and IV construction, where at least all portions of the roof within 40 ft. (12.2m) on each side of the fire wall are of noncombustible construction, the fire wall may terminate at the underside of the roof deck. Parapets are required on party walls in all cases.

Additional requirements for parapets are found in Section 1507 of the code.

The horizontal extension of party walls and fire walls beyond exterior intersecting walls of combustible construction, or exterior noncombustible walls with combustible projections or veneers, shall not be less than 18 inches (457 mm). Similarly, party walls and fire walls shall extend not less than 18 inches (457 mm) past any combustible projection or veneer. Party walls and fire walls shall extend to the inside facing of the exterior surface of noncombustible exterior intersecting walls, provided there are no combustible projections or veneers (see Section 704.5.1.2).

Openings

Openings in fire walls are permitted, provided they are protected with approved, 3-hour rated, Class a opening protectives (fire doors and fire dampers). Fire doors shall be equipped with an approved closer, and no glass is permitted. The maximum size of a fire door shall not exceed that specified in Appendix C, NFPA 80.[4] Additional requirements for fire doors and their accompanying hardware are specified in Section 705.1.3 of the code. Fire dampers shall comply with the requirements of standard UL 555[5] and bear the label of an approved testing agency (see Section 705.1.2.2).

Openings in party walls are not permitted, except in the case of separation of townhouses where the walls comply with the provisions of Section 704.4.2.

Penetrations

The provisions for protecting fire wall penetrations are contained in Section 705.4.3 of the code. All penetrations (pipes, tubes, and conduits), and cables and wires with, and without combustible jackets and insulations, are permitted in fire wall construction under the following

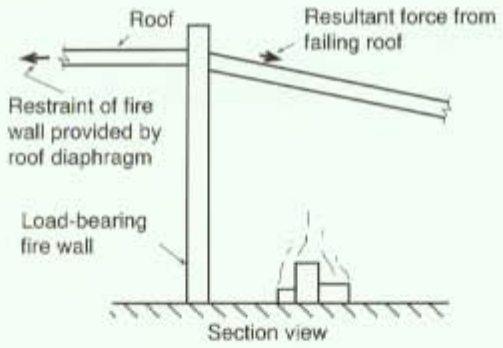


Fig. 2a. Restraint condition of fire wall with nonyielding connections.

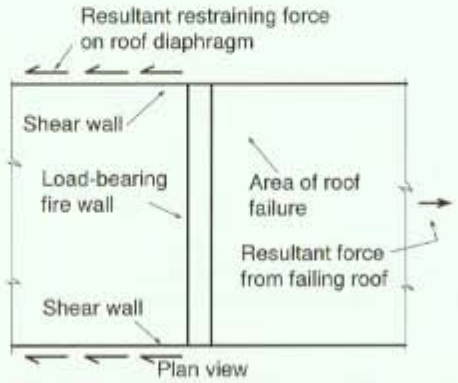


Fig. 2b. Plan view of forces acting during failure.

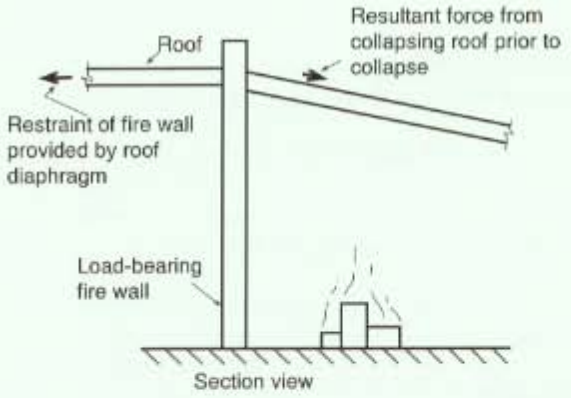


Fig. 3a. Restraint condition of fire wall with yielding connections before roof collapse.

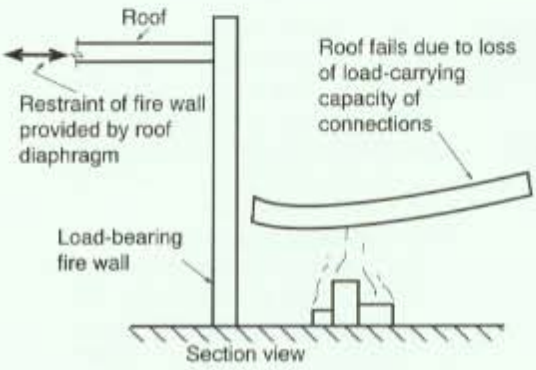


Fig. 3b. Restraint condition of fire wall with yielding connections after roof collapse.

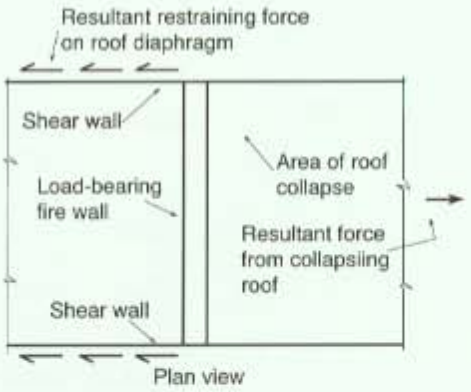


Fig. 3c. Plan view of forces acting before roof collapse.

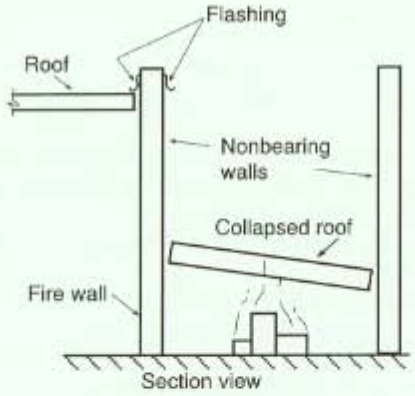


Fig. 4a. Fire wall with no restraint at roof after collapse (free standing).

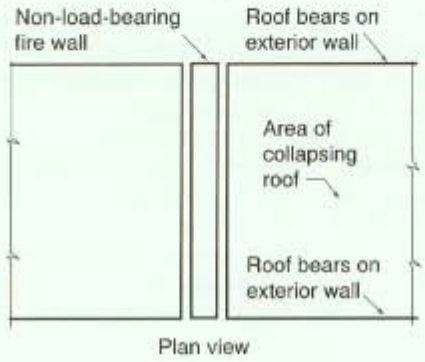


Fig. 4b. Fire wall with no restraint at roof before collapse (free standing).

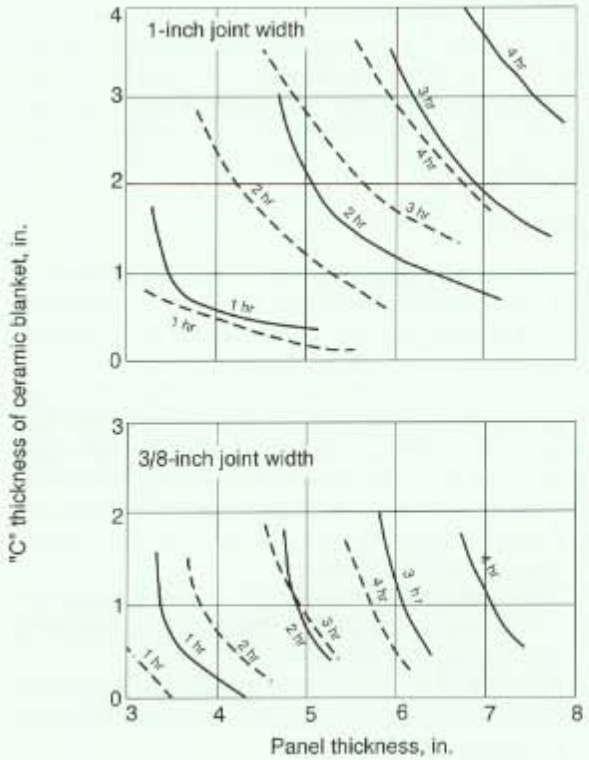


Fig. 5. Determination of joint thickness between precast concrete wall panels.

conditions: (1) penetrations are protected through the use of an approved through-penetration firestop system as prescribed in Section 705.4.7; or (2) penetrating elements have passed an ASTM E119 test when tested as part of the fire resistant assembly.

For noncombustible penetrations, and wires and cables without combustible jackets, a third option is available within the limitations specified in Section 705.4.6.2. If the gross cross-sectional area of the penetrating item does not exceed 36 sq. in. (23,226 sq. mm), and the width of the annular space between the penetrating item and the wall does not exceed 1-1/2 in. (38 mm), the penetration can be protected by filling the annular space with concrete, mortar, or grout for the full thickness of the wall, or to an equivalent thickness necessary to provide the required fire resistance rating of the wall (4 hours). Provisions concerning sleeves and insulating covers are addressed in Sections 705.4.6.3 and 705.4.6.4, respectively.

Conceptual Design of Fire Walls

In many ways, a fire wall is no different from other walls. It can be used in a non structural capacity or as a load bearing element when designed to the structural provisions of the code. When a fire wall is used as a shear wall and/or bearing wall, special attention must be paid to wall-roof, and wall-floor connections such that the fire wall will still be able to meet the collapse criteria as defined in Section 202. Types of connections and restraining conditions necessary to stabilize a fire wall against collapse during a fire are conceptually illustrated in Figs. 2, 3, and 4. Details pertaining to fire resistance requirements and fire wall components have been omitted.

Concrete and Masonry Wall Joints

Design considerations that apply to spacing of joints for interior concrete and masonry walls also apply to concrete and masonry fire walls. Although this

discussion is beyond the scope of the report, a number of industry publications are available on the subject.[6,7,8,9,10] Where precast concrete or tilt-up construction is utilized for fire walls, joints between panels should be protected in accordance with Section 709.2.1.3 (and Fig. 709.2.1.3) of the code.

Summary

This report explains provisions of the SBC pertinent to concrete and masonry fire walls. Key points regarding concrete and masonry fire walls can be summarized as follows:

1. The function of a fire wall is to contain the most severe anticipated fire for the duration of the assembly's rating period such that the fire does not spread from one side of the wall to the other.
2. Three characteristics of code-required fire walls are
   a. Areas on opposite sides of fire walls are considered separate buildings.
   b. The number required in a structure is governed by allowable area limits, based on occupancy and type of construction.
   c. All fire-wall openings and penetrations must be protected by approved fire-rated assemblies or protection methods.
3. In terms of physical characteristics, the principal distinction between fire walls and other wall assemblies lies in their superior fire resistance and ability to withstand the collapse of construction on either side of the wall without collapse of the wall itself.
4. Fire walls are permitted to be used as structural elements when designed in accordance with the appropriate provisions of the code.

References

1. *Fire Protection Handbook*, 16th ed., National Fire Protection Association, Boston, Massachusetts, 1986.
2. ASTM Designation E 119-88, *Standard Test Methods for Fire Tests of Building Construction and Materials*, Section 4, Vol. 4 .07, American Society for Testing and Materials, Philadelphia, Pennsylvania, 1993.
3. *1994 Standard Building Code*, Southern Building Code Congress International, Inc., Birmingham, Alabama, 1994.
4. "Standard for Fire Doors and Windows," NFPA 80, National Fire Codes, National Fire Protection Association, Quincy, Massachusetts, 1992.
5. "Standard for Fire Dampers and Ceiling Dampers," UL 555, Underwriters Laboratories, Inc., Northbrook, Illinois, 1990.
6. *Volume Changes and Effect of Movement - Part I*, BIA Technical Notes on Brick Construction, No. 18 (Revised Jan. 1991), Brick Institute of America, Reston, Virginia, January 1991.
7. *Design and Detailing of Movement Joints - Part II*, BIA Technical Notes on Brick Construction, No. 18A (Revised Dec. 1991), Brick Institute of America, Reston, Virginia, December 1991.
8. *Control of Wall Movement with Concrete Masonry*, NCMA-TEK 10-2 (formerly TEK 3), National Concrete Masonry Association, Herndon, Virginia, 1972.
9. *Design of Concrete Masonry for Crack Control*, NCMA-TEK 10-1 (formerly TEK 53), National Concrete Masonry Association, Herndon, Virginia, 1973.
10. *Building Movement and Joints*, EB086B, Portland Cement Association, Skokie, Illinois, 1982.

Member Organizations of the
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ACI	American Concrete Institute
ASCC	American Society for Concrete Construction
BIA	Brick Institute of America
ESCSI	Expanded Shale Clay & Slate Institute
NAA	National Aggregates Association
NCMA	National Concrete Masonry Association
NRMCA	National Ready Mixed Concrete Association
NSA	National Stone Association
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
TCA	Tilt-up Concrete Association
WRI	Wire Reinforcement Institute

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