fire protection planning report

BUILDING CONSTRUCTION INFORMATION FROM THE CONCRETE AND MASONRY INDUSTRIES

NO. 16S OF A SERIES

Guide to SBC Requirements for Concrete and Masonry Fire Walls

Introduction

Properly designed and constructed fire walls provide an effective means of stopping or controlling 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 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 when fire walls used for compartmentation are constructed of concrete or masonry.

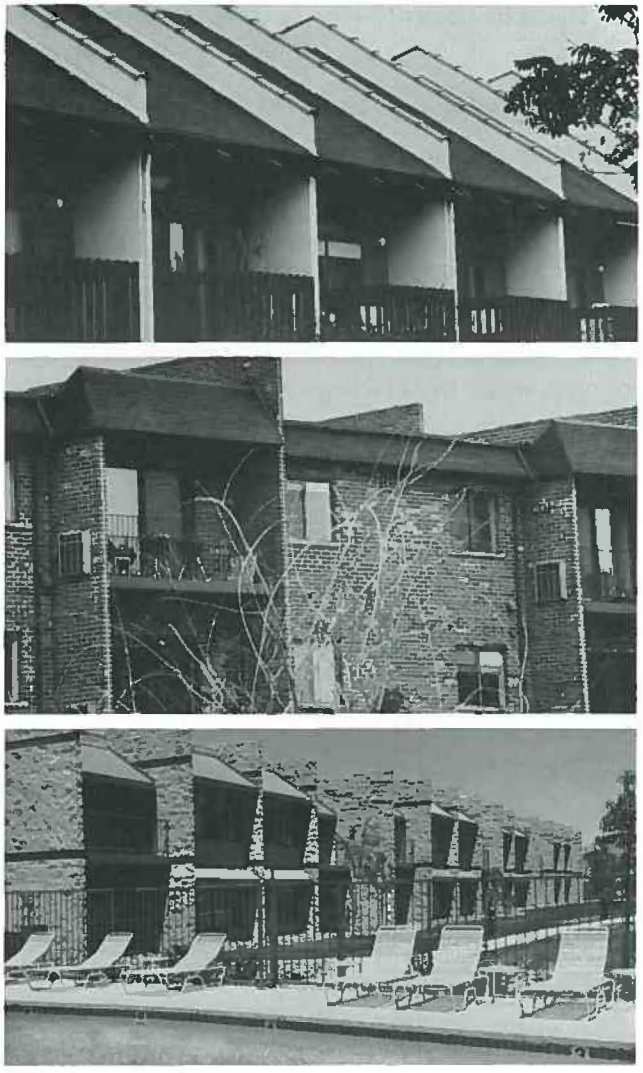
Fire walls must meet rating requirements specified in the SBC in accordance with ASTM E119 test procedures.[2] Structural and other requirements of the code must also be considered in fire-wall design, but these are outside the scope of this report. The text that follows will generally focus only on the fire-related provisions for concrete and masonry fire walls, based on the 1985 edition of the SBC.[3]

Purpose

The purpose of this report is to provide building officials and the design community with information on the code requirements germane to 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, and so forth)
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 share the following characteristics:

1. Areas divided by them, for purposes of allowable heights and areas, are considered separate buildings
2. The number needed in a structure is generally governed by height and area restrictions that are based on occupancy and construction type
3. All openings in fire walls must be protected by appropriate fire-rated assemblies

What Is a Fire Wall?

The SBC defines a fire wall as follows:

> Fire wall—a 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. The code does not allow openings in party walls.

Fire-Resistance Requirements

All fire walls are required to have a fire-endurance rating of four hours per Table 600 of the code. There is, however, a unique case where a structure can be separated into two distinct buildings without the use of a fire wall. In townhouses not exceeding three stories, a two-hour-rated wall separation is acceptable if it meets the detailed criteria in Section 403.3 of the code.

In an unrelated case, one other assembly worth mentioning is where two buildings of different heights share a common fire wall. In this scenario, rating requirements for fire walls only apply to that part of the wall up to the point where the fire wall would normally terminate on the shorter of the two buildings. The part of the wall above the termination point would have to comply with Table 600 requirements for exterior walls with zero horizontal separation distance. Any openings above and less than 15 feet from the lower roof shall be equipped with approved opening protectives. This scenario is shown in Fig. 1.

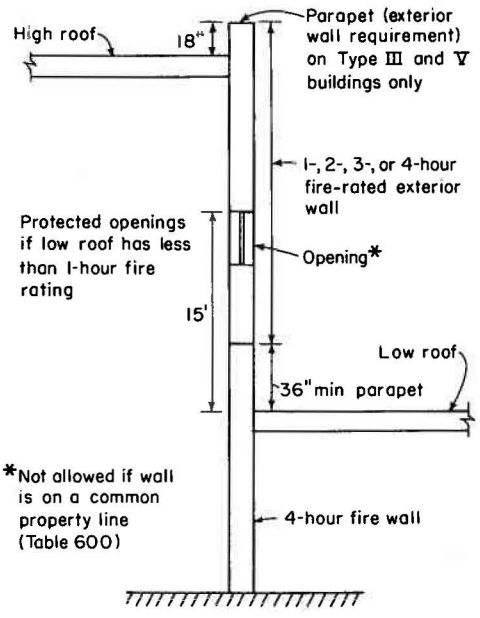


Fig. 1. SBC fire-wall requirements for unequal building heights.

Rational methods for determining fire-endurance ratings of concrete and masonry walls are described in Appendix P of the code.[4]

When Are Fire Walls Required?

For new construction, height and area restrictions determine the number of fire walls that a given structure will need. These requirements are a function of construction type and occupancy and are provided in Table 400 of the code. The values in the table are modified by Sections 402.2, 402.3, 402.4, and other sections in Chapter 4 that cover special building uses.

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, openings, and penetrations—are discussed below.

Parapets

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.

Note *a* of Table 600 requires parapets on party walls and fire walls to extend not less than three feet above the roof. In Types I, II, and IV construction where all portions of the roof are of noncombustible construction within 40 ft on each side of the fire wall, the fire wall may terminate at the underside of the roof deck. Parapets are required on party walls in all cases.

General requirements for parapet walls are found in Section 1406 of the code.

Openings

The only openings allowed in fire walls are door openings,* and they must be protected by three-hour-rated Class A doors. 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 Table B-1 of Appendix B, National Fire Protection Association Standard 80.[5] However, Section

*Openings are not permitted in party walls.

703.3.2 permits larger doors subject to the building official's approval.

Penetrations

The penetration of fire walls by electrical, telephone, plumbing, air conditioning, intercommunication systems, or similar facilities shall not be permitted unless such openings are installed in such a manner that the required fire resistance is not decreased.

Conceptual Design of Fire Walls

In many ways, a fire wall is no different from other walls. It can be used in a nonstructural capacity or as a load-bearing element when designed to the structural provisions of the code. When used as a shear or bearing wall, special attention must be paid to wall-roof connections such that the wall will still be able to meet the collapse criteria defined earlier per Section 202 of the code. Types of connections and restraining conditions necessary to stabilize the fire wall against collapse during a fire are conceptually illustrated in Figs. 2, 3, and 4. Requirements corresponding to fire resistance and fire-wall components are shown in Fig. 1.

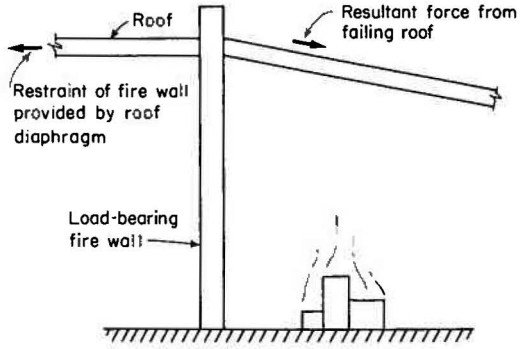


Fig. 2a. Restraint condition of fire wall with nonyielding connections.

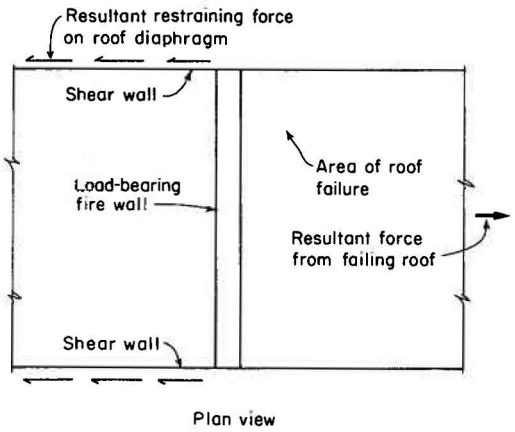


Fig. 2b. Plan view of forces acting during failure.

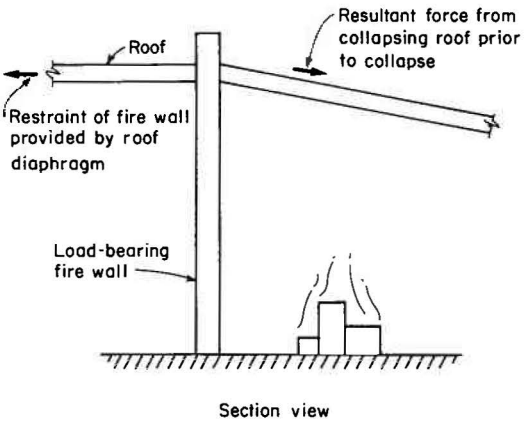


Fig. 3a. Restraint condition of fire wall with yielding connections before roof collapse.

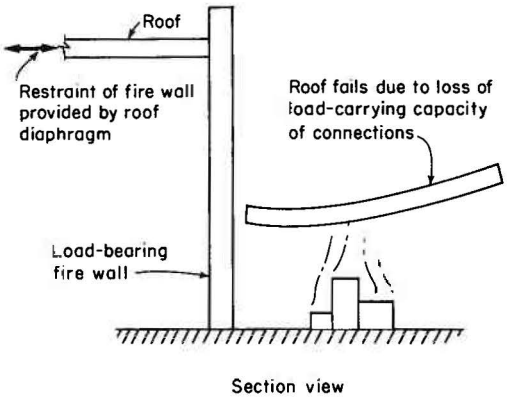


Fig. 3b. Restraint condition of fire wall with yielding connections after roof collapse.

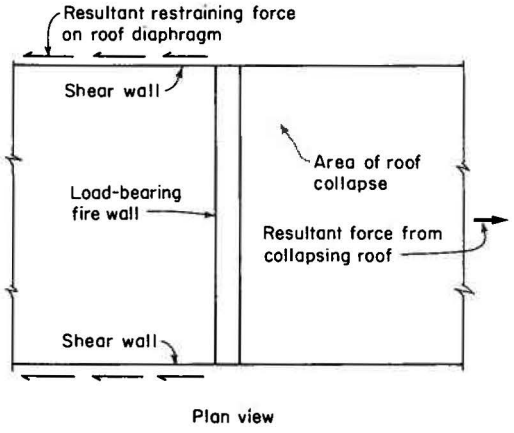


Fig. 3c. Plan view of forces acting before roof collapse.

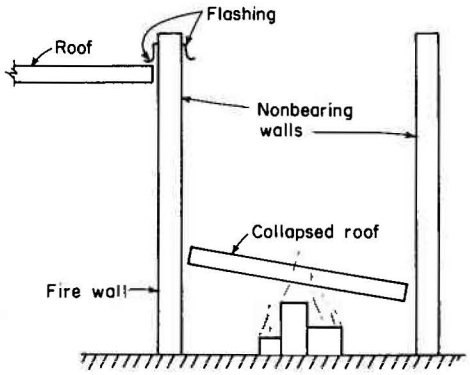


Fig. 4a. Fire wall with no restraint at roof after collapse (free standing).

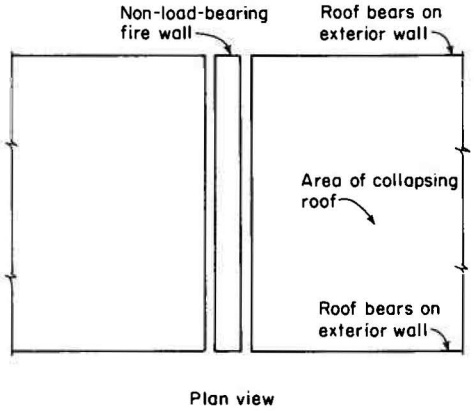


Fig. 4b. Fire wall with no restraint at roof, before collapse (free standing).

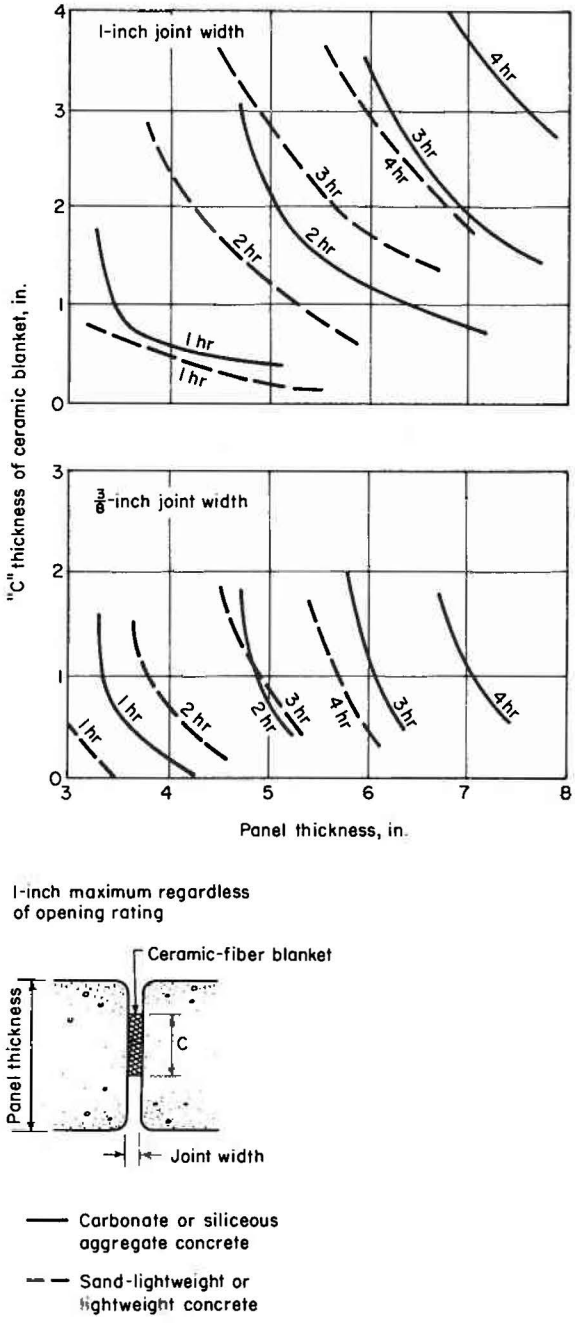


Fig. 5. Determination of joint thickness between precast concrete wall panels.

Concrete and Masonry Wall Joints

The rules that govern joint selection 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 good industry publications are available on the subject.[6,7,8,9]

Where tilt-up construction is utilized for fire walls, joints between panels should be protected as shown in Fig. 5.[4] The figure specifies the minimum thickness of ceramic-fiber blanket* required between wall panels to provide fire-resistance ratings from one to four hours. Ratings are based on joint widths of ⅜ in. and 1 in. for a variety of panel thicknesses. Direct interpolation of the curves can be made for joint widths between ⅜ in. and 1 in.

Summary

This report contains sections from the SBC specifically pertinent to concrete and masonry fire walls. The text may be applicable to fire walls constructed of other materials but should not be assumed as such. In retrospect, the key points regarding concrete and masonry fire walls can be summarized as follows:

1. The function of a fire wall is to contain effectively 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.

*Ceramic-fiber blanket—a mineral wool insulation material made of alumina-silica fibers and weighing 4 to 10 lb per cubic foot.

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 generally governed by allowable height and area limits, based on occupancy and type of construction
   c. All fire-wall openings must be protected by approved fire-rated assemblies
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 may be used structurally 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 119-83, *Standard Methods of Fire Tests of Building Construction and Materials,* Section 4, Vol. 4.07, American Society for Testing and Materials, Philadelphia, Pennsylvania, 1985.
3. *Standard Building Code,* Southern Building Code Congress International, Inc., Birmingham, Alabama, 1985.
4. "Appendix P—Calculated Fire Resistance," *Standard Building Code,* Southern Building Code Congress International, Inc., Birmingham, Alabama, 1985, page 475.
5. "Standard for Fire Doors and Windows," NFPA 80, *National Fire Codes,* Vol. 3, National Fire Protection Association, Quincy, Massachusetts, 1985.
6. *Differential Movement—Cause and Effect,* BIA Technical Notes on Brick Construction, No. 18, Brick Institute of America, McLean, Virginia, July 1984.
7. *Control of Wall Movement with Concrete Masonry,* NCMA-TEK 3, National Concrete Masonry Association, Herndon, Virginia, 1972.
8. *Design of Concrete Masonry for Crack Control,* NCMA-TEK 53, National Concrete Masonry Association, Herndon, Virginia, 1973.
9. *Building Movement and Joints,* EB086B, Portland Cement Association, Skokie, Illinois, 1982.

Organizations represented on the Concrete and Masonry Industry Firesafety Committee

BIA	Brick Institute of America
CRSI	Concrete Reinforcing Steel Institute
ESCSI	Expanded Shale Clay and Slate Institute
NCMA	National Concrete Masonry Association
NRMCA	National Ready Mixed Concrete Association
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute

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