The Code Corner

RLGA Technical Services

No. 37 — Fall 2011

Fire Walls

By Ronald L. Geren, AIA, CSI, CCS, CCCA, SCIP

Passive fire protection has been a significant component of building codes since the publication of the first Building Code recommended by the National Board of Fire Underwriters (NBFU) in 1905—even Nero established some form of passive fire protection in Rome after it burned in 64 A.D. *Passive fire protection* is the use of building materials to limit the effects of fire on a building or to contain the spread of fire within a building or between separate buildings. In the 1905 edition of the NBFU Building Code, passive fire protection, which came in the form of "Fireproof Buildings," was determined through prescriptive requirements based solely on the use of materials such as brick, stone, concrete, iron, and steel, without consideration of how well the materials performed under actual fire conditions.

However, over the past 100 years, building codes have continually been improved to reflect new technologies and unfortunately, to respond to tragic events such as the attacks on the World Trade Center on September 11, 2001. Additionally, testing standards have also developed over time and have become an integral part of building code compliance. For example, in 1918 the American Society for Testing and Materials, or ASTM (now only called ASTM International) published its first standard for the fire testing of materials as standard C19, which is now known as ASTM E 119, *Standard Test Methods for Fire Tests of Building Construction and Materials*. For many years, ASTM E 119 has been the basis for determining the fire resistance of building construction in model building codes, but in the 2009 *International Building Code* (IBC), Underwriters Laboratories (UL) 263, *Fire Tests of Building Construction and Materials*, was added as an alternative.

In the IBC, fire-resistive construction is used to satisfy requirements for type of construction or for assemblies such as fire barriers, fire partitions, smoke barriers, horizontal assemblies, and fire walls. The last of that list—fire walls—can serve two purposes. Unlike other fire-resistive assemblies, a fire wall is used to divide a large, single building on the same lot into two or more buildings, or to serve as a shared wall between two buildings on different lots.

Dividing a Building on the Same Lot – This application of a fire wall can achieve one or both of the following objectives:

1. To divide a large building into smaller "buildings" in order to permit the application of a less restrictive construction type that has a lower allowable area. For example, if a Group B, Type VA building is permitted 18,000 sq. ft. in floor area (without sprinklers), a fire wall can divide the building in half to create two 9,000 sq. ft. "buildings" of Type VB construction.
2. To separate a building into two or more "buildings" so that different construction types may be used. This is commonly used for additions to existing buildings when it is desired to have an addition that does not conform to the requirements of the existing building's construction type. For example, if the design team wants to add a Type VB combustible addition to an existing building of Type IIB noncombustible construction, a fire wall is required between the two types of construction.

Separating Buildings on Different Lots – A fire wall used for this purpose is called a "party wall" and is situated on the lot line and is shared by each building on each lot. Per Section 706.1.1 of the IBC[1], fire walls used as party walls are not permitted to have openings.

Materials and Fire-Resistance Ratings

Fire wall materials are limited to noncombustible materials such as masonry, concrete, and metal studs with gypsum board. Combustible construction, such as wood studs, is only permitted in Type V construction.

The fire-resistance rating of a fire wall depends on the occupancy group or groups divided by the fire wall, and to a lesser extent, the construction type. The minimum fire-resistance rating is 2 hours, but fire walls can have ratings of 3 and 4 hours. Table 706.4 provides the required ratings for fire walls and, per the footnotes, allows some exceptions. For example, a Group B building is required to have a 3-hour fire wall; however if the building is of Type II or V construction, the rating can be reduced to 2 hours.

If the fire wall separates buildings of differing occupancy groups, the most restrictive rating shall be used. Where a fire wall also serves as a required separation between occupancy groups or fire areas, the most restrictive fire-resistance rating of either the fire wall or the fire barrier separating wall shall be applied. The same restriction also applies to differing construction types. If the fire wall separates two buildings of different construction type, the most restrictive application shall be used. For example, if a Group B building is divided by a fire wall and one building is of Type I construction and the other is of Type II construction, a 3-hour fire wall is required, even though the Type II construction is permitted a reduction to 2 hours.

Fire Wall Design

Although the role of a fire wall in a building's passive fire protection system may sound simple in concept, it is the understanding of fire wall design that seems to be elusive to many design professionals. One of the more confusing design features of a fire wall is the requirement for structural stability—the fire wall must remain in place if the building on either side of the fire wall collapses. To maintain the required structural stability, fire walls are often independent of a building's structural system, thus allowing the structural frame of a building to fail and not bring down the fire wall along with it.

For floors and roofs that are framed using combustible wood members, such as glue-laminated or heavy timber construction, the structural members can bear on a fire wall without compromising the fire wall's structural stability and fire-resistive performance. These structural members, when embedded in the fire wall, must have what is known as a "fire cut" to allow the member to fall out of the embedment without damaging the structural integrity of the fire wall. However, when these combustible structural members are embedded in the fire wall, per Section 706.7 there must be a minimum of 4 inches between the ends of the structural members. If the wall is hollow, such as with concrete masonry units, then the hollow spaces must be filled solidly for the full thickness of the cavity for a distance of 4 inches above, below, and in between the structural members.

[1] References to the IBC in this article are for the 2009 Edition.

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Horizontal Continuity

Since a fire wall is required to extend from exterior wall to exterior wall (Section 706.5), the termination of a fire wall at the exterior wall can be a little confusing. The basic requirement in the IBC states that a fire wall must extend 18 inches beyond the exterior surface of the exterior wall. However, three exceptions are offered that eliminate the wall extension:

1. The fire wall may terminate at the interior surface of exterior combustible sheathing or siding, provided the exterior wall has a 1-hour fire-resistance rating that extends 4 feet on each side of the fire wall and any openings within this protected area have a fire protection rating of 45 minutes.
2. The fire wall may terminate at the interior surface of noncombustible sheathing, siding, or other material, provided the noncombustible material extends at least 4 feet on each side of the fire wall.
3. The fire wall may terminate at the interior surface of noncombustible sheathing where the building on each side of the fire wall is sprinklered in accordance with the National Fire Protection Association's (NFPA) 13, *Installation of Fire Sprinkler Systems*, or NFPA 13R, *Installation of Fire Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height*, with IBC exceptions.

The requirement and exceptions described above are applicable to fire walls that terminate at exterior walls that are 180 degrees or more from each other. However, when fire walls intersect exterior walls that are less than 180 degrees apart, other requirements come into play. Per Section 706.5.1, there are two options available for working with this type of exterior wall condition. Option 1 is a simple method that requires the exterior walls within 4 feet on each side of a fire wall to be constructed of 1-hour fire-resistive construction and any openings within this protected area must have a minimum 45-minute fire protection rating (See Figure 1). Option 2 is a little more complex and involves the application of an imaginary lot line that extends from the termination of the fire wall to a point beyond the building or to an actual lot line so as to determine exterior wall and opening protection per Sections 705.5 and 704.8, respectively (See Figures 2 and 3).

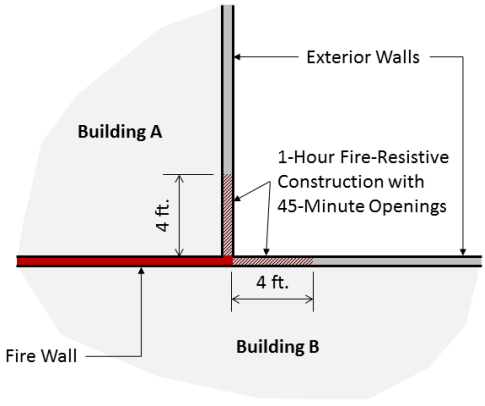

Figure 1 – Termination of fire wall at exterior walls less than 180° apart using Option 1 simple prescriptive method

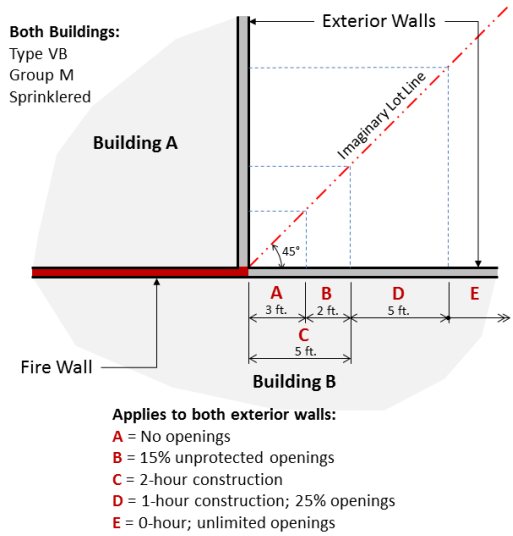

Figure 2 – Example of terminating fire wall at exterior walls less than 180° apart using Option 2 fire separation distance method.

Building elements that project horizontally from the face of an exterior wall, such as balconies, roof overhangs, and canopies, provide opportunities for fire to circumvent fire wall construction. Therefore, the IBC requires that fire walls extend to the outer edge of projecting elements when they are within a distance of 4 feet of the fire wall (See Figure 4). Typical of most code requirements, there are exceptions:

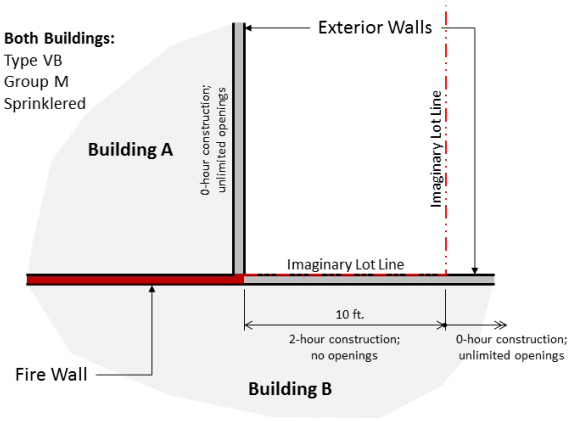

Figure 3 – Another Option 2 example using a different imaginary lot line location.

1. If the projecting element *does not* include concealed spaces, the fire wall need only comply with the basic requirements for fire wall horizontal continuity when the wall behind and below the projecting element is constructed of 1-hour fire-resistive construction for a distance equal to the depth of the projecting element on each side of the fire wall. Openings within the protected exterior wall area must have a minimum fire protection rating of 45 minutes (See Figure 5).

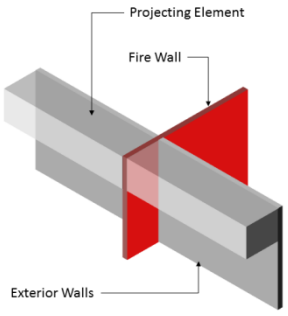

Figure 4 – Requirement for fire wall through projecting element.

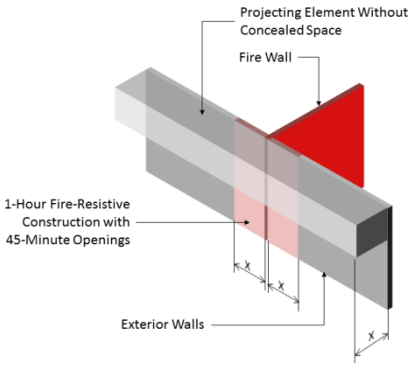

Figure 5 – Requirement for fire wall through projecting elements without concealed space.

2. If the projecting element is noncombustible and *does* include concealed spaces, then the installation of a 1-hour fire-resistive wall through the concealed space that aligns with the fire wall is required. The construction of the projecting element must be of 1-hour fire-resistive construction for a distance equal to the depth of the projecting element on each side of the fire wall (See Figure 6). The separation wall below the projecting element may be omitted provided the exterior wall below the projecting element is of 1-hour fire-resistive construction for a distance equal to the depth of the projecting element on each side of the fire wall (See Figure 7). Openings within the protected exterior wall area must have a minimum fire protection rating of 45 minutes.

3. If the projecting element is combustible and *does* include concealed spaces, then the fire wall is only required to extend through the projecting element to the outer edge. The construction of the exterior wall below and behind the projecting element must be of 1-hour fire-resistive construction for a distance equal to the depth of the projecting element on each side of the fire wall. Openings within the protected exterior wall area must have a minimum fire protection rating of 45 minutes (See Figure 8).

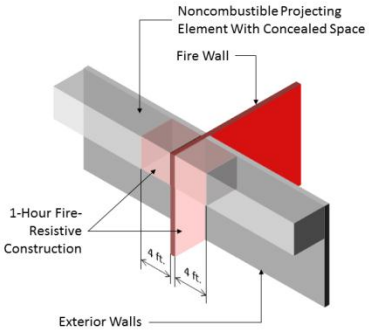

Figure 6 – Requirement for fire wall through noncombustible projecting element with concealed space.

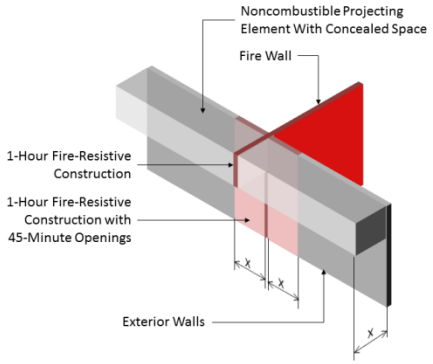

Figure 7 – Alternate requirement for fire wall through noncombustible projecting element with concealed space.

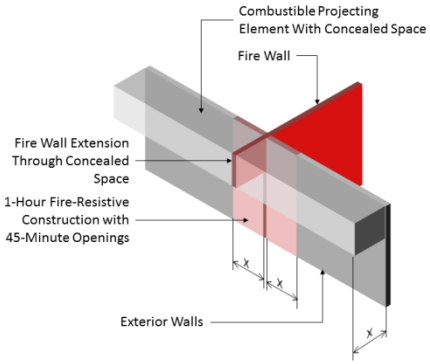

Figure 8 – Requirement for fire wall through combustible projecting element with concealed space.

Vertical Continuity

In addition to the horizontal extension of fire walls to the exterior walls, fire walls are also required to extend from the foundation to a point that is 30 inches above the adjacent roof surfaces (See Figure 9). As with exterior walls, the vertical extension of a fire wall also has exceptions:

1. Fire walls in stepped buildings must extend 30 inches above the lower roof surface, and for 15 feet above the lower roof, the exterior wall must be protected with 1-hour fire-resistive construction and any openings in the protected area must have a minimum fire protection rating of at least 45 minutes (See Figure 10).
2. 2-hour fire walls may terminate at the underside of roof sheathing, decks, or slabs, provided the lower roof assembly is constructed of 1-hour fire-resistive construction within 4 feet of the fire wall and the supporting elements for the roof assembly are protected for the full length with an equal fire-resistive rating. Also, no openings are permitted within the 4-foot protected area and the roof must have a Class B roof covering (See Figure 11).
3. Fire walls may terminate at the underside of noncombustible roof sheathing, decks, or slabs, provided the building on each side has a Class B roof covering and no openings are located within 4 feet of the fire wall (See Figure 12).

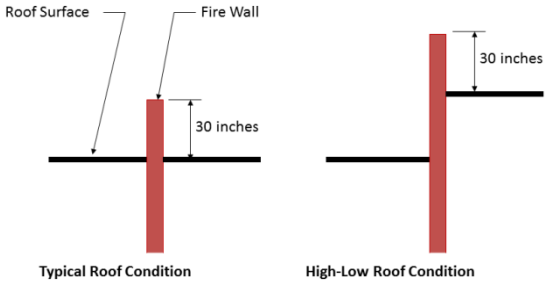

Figure 9 – Vertical extension of fire wall through roof.

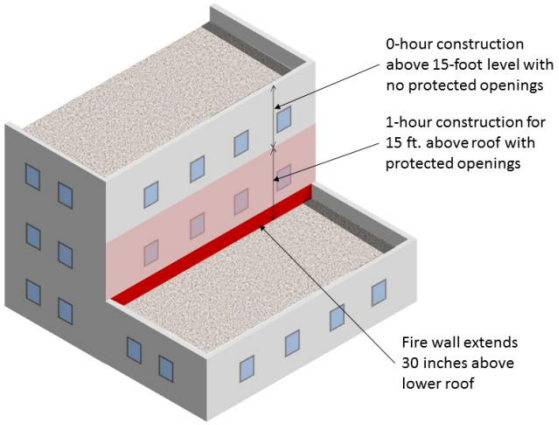

Figure 10 – Fire wall extension through roof for stepped buildings.

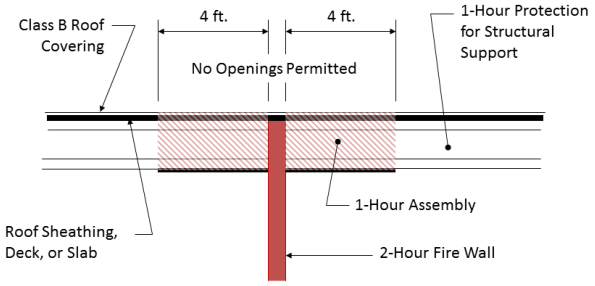

Figure 11 – 2-hour fire wall termination at underside of roof.

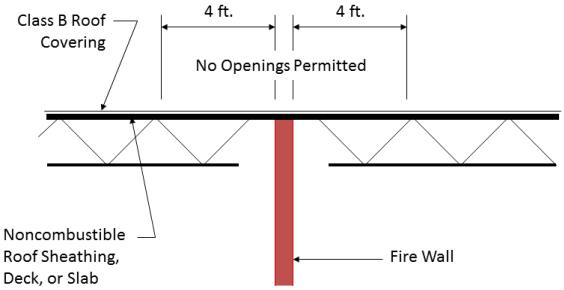

Figure 12 – Fire wall termination at noncombustible roofs.

Openings and Joints

Openings are permitted in fire walls and are discussed in detail in *The Code Corner* No. 34 "Openings – Part 1." Joints within fire walls and between fire walls and other fire-resistive construction, such as floor or floor-ceiling assemblies and roof or roof-ceiling assemblies, must be protected for a time period that is not less than the required rating of the fire wall, roof, or floor.

4. Fire walls in buildings of Type III, IV, and V construction may terminate at the underside of combustible roof sheathing or decks provided the sheathing or deck is constructed of fire-retardant-treated wood extending at least 4 feet on each side of the fire wall or the sheathing or deck is protected by 5/8-inch-thick Type X gypsum board applied directly to the underside of the sheathing or deck for a distance of 4 feet on each side and supported by 2-inch nominal ledgers. Also, no openings are permitted within 4 feet of the fire wall and the roof must be covered by a Class B roof covering (See Figure 13).

5. Buildings permitted to be separated by a 3-hour horizontal assembly per Section 509.2 (commonly referred to as "podium" construction), may have the fire wall terminate at the horizontal separation and need not extend to the foundation.

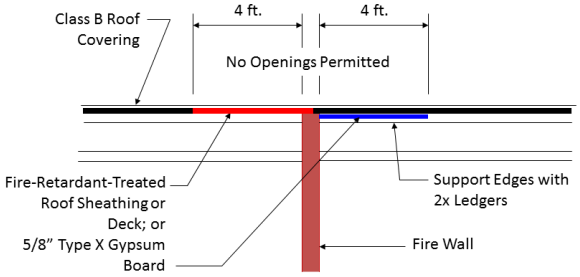

Figure 13 – Fire wall termination at combustible roofs for Type III, IV, and V construction. Left side shows fire-retardant-treated wood option and right side shows gypsum board application method.

Fire Wall Alternatives

Fire walls are frequently considered as single wall assemblies, but a single wall is only one method of achieving the required structural and fire-resistive performance. Double-wall assemblies can be provided as an alternative using the prescriptive requirements in the IBC. These methods provide a cost-effective solution when a fire wall is needed between an existing building and a new addition.

If a building on the same lot is divided by a fire wall and no openings are planned within the fire wall, a double-wall option can be utilized using the requirements for exterior wall construction where each wall is considered to be adjacent to an imaginary lot line. For example, assume a Type V, Group B building is divided by a double-wall fire wall along an imaginary lot line. Since the fire separation distance is less than 5 feet, the fire-resistive rating is required to be 1-hour per Table 602. Therefore, each wall must

have a 1-hour rating. If a single fire wall were used, the rating would have to be 2-hours. However, although a single-wall fire wall is allowed openings, when using the double-wall option as exterior walls, the individual walls are not permitted openings per Table 705.8, since the fire separation distance is less than 3 feet per.

If a fire wall with openings is required, then the double-wall method is still an option; however, the design of the openings becomes a challenge. As stated earlier, the structural stability of the fire wall is paramount and the double-wall fire wall allows each wall within the assembly to support the floors and roof of its respective "building," allowing either building to collapse along with its side of the fire wall, leaving the other wall intact. But openings through these double-wall assemblies must also remain in place if either wall collapses, and herein lies the complexity of double-wall fire walls.

Unless double doors are used, such as that between adjoining rooms in a hotel (which would not allow them to be used as means of egress doors), then openings through a double-wall fire wall must be designed as structurally independent elements and cannot be anchored to either wall of the double-wall assembly. Therefore, frames of openings must have their own foundation systems that will keep them erect if either wall collapses.

Unlike the exterior wall method, the fire-resistance rating for each wall in a double-wall fire wall will require the same rating as that for a single-wall fire wall. However, an alternative method is available that can be proposed to the building official using Section 104.11, "Alternative materials, design and methods of construction and equipment," if using the 2009 or earlier editions of the IBC (the 2012 IBC includes this alternative). The alternate method employs the use of NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls*. This standard essentially provides the same method described above for double-wall fire walls with openings, but the NFPA standard allows a 1-hour reduction in the fire-resistance rating of each wall in the double-wall assembly. Thus, a 2-hour fire wall may be constructed using two 1-hour walls.

In some articles about fire-resistive construction, the term "fire wall" is incorrectly applied to other fire-resistive assemblies used for passive fire protection, such as fire barriers, fire partitions, and smoke barriers. Although these assemblies serve their respective purposes, the fire wall has a unique place in the passive fire protection arsenal; thus, when a fire wall is utilized in a building, the special requirements associated with fire walls need to be carefully studied and incorporated where applicable. Another thing that some tend to overlook when using a fire wall is that it provides a side benefit of also creating a horizontal exit, provided the doors and refuge areas comply with Section 1025 (See *The Code Corner* No. 24, "Horizontal Exits").

About the Author: Ronald L. Geren, AIA, CSI, CCS, CCCA, SCIP, is an ICC Certified Building Plans Examiner, and is the principal of RLGA Technical Services located in Scottsdale, Arizona, which provides specifications and code consulting services to architects, engineers, owners, and product manufacturers. A 1984 graduate of the University of Arizona, Ron has over 26 years of experience with military, public, and private agencies. You can contact Ron Geren at ron@specsandcodes.com.

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