FIRE WALLS, FIRE BARRIERS AND FIRE PARTITIONS

INTRODUCTION

This section supplements NFPA 221. NFPA 221 has now defined two different types of fire walls, High Challenged Fire Walls and Fire Walls. The requirements for a high challenged fire wall are the same as our defined standard and MFL fire walls. All fire walls and fire barrier walls should be designed and installed in accordance with NFPA 221 as modified by this section.

Fire walls are the last line of defense against the spread of a fire. Many modern facilities have large areas for hazardous processes and storage of products, and fire walls are needed to limit the amount of material exposed in a single fire area.

NFPA 221 defines fire walls as “a wall separating buildings or subdividing a building to prevent the spread of fire and having a fire resistance rating and structural stability” even if complete collapse of structures occur on either side of a fire wall. NFPA 221 states high challenged fire walls must be nonloadbearing, and must be designed to maintain structural integrity even if complete collapse of structures occur on either side of a fire wall. To maintain the structural stability, long or high fire walls may be buttressed by cross walls or built with pilasters.

Fire walls, fire barriers and fire partitions must prevent heat and flame from passing through them. To perform their functions, they must be built in accordance with acceptable laboratory testing standards and maintained to ensure continued ability to withstand a fire.

Fire barriers and fire partitions have lower fire resistance ratings than fire walls. Fire barriers and fire partitions subdivide floors and could be attached to or be supported by structural members.

This document describes how fire walls, fire barriers and fire partitions are constructed and maintained. The use of fire walls and where to provide them depends upon the type of occupancy and the presence of hazards. In some instances, fire walls may also be constructed as explosion-resistant walls. Such walls should be designed as outlined in this section and be capable of withstanding the forces associated with explosions as indicated in NFPA 68.

POSITION

Definitions

Fire Walls

AXA XL Risk Consulting further classifies three types of firewalls. A “standard fire wall” is a blank, parapeted, non-load bearing (freestanding, double, or tied firewalls), masonry fire wall constructed of material with at least a 4 h fire resistance rating. A “MFL wall” is a parapeted, non-load bearing, fire wall constructed of materials with at least a 4 h fire resistive rating. A “fire wall” is a parapeted wall,

constructed of material with at least a 3 h fire resistance rating. Protect openings in the MFL fire wall and the fire wall with equivalent fire resistant rated materials/assemblies. Protected columns within the tied and double fire walls can carry the gravity load. All masonry wall material should be non-load bearing.

Fire Barriers

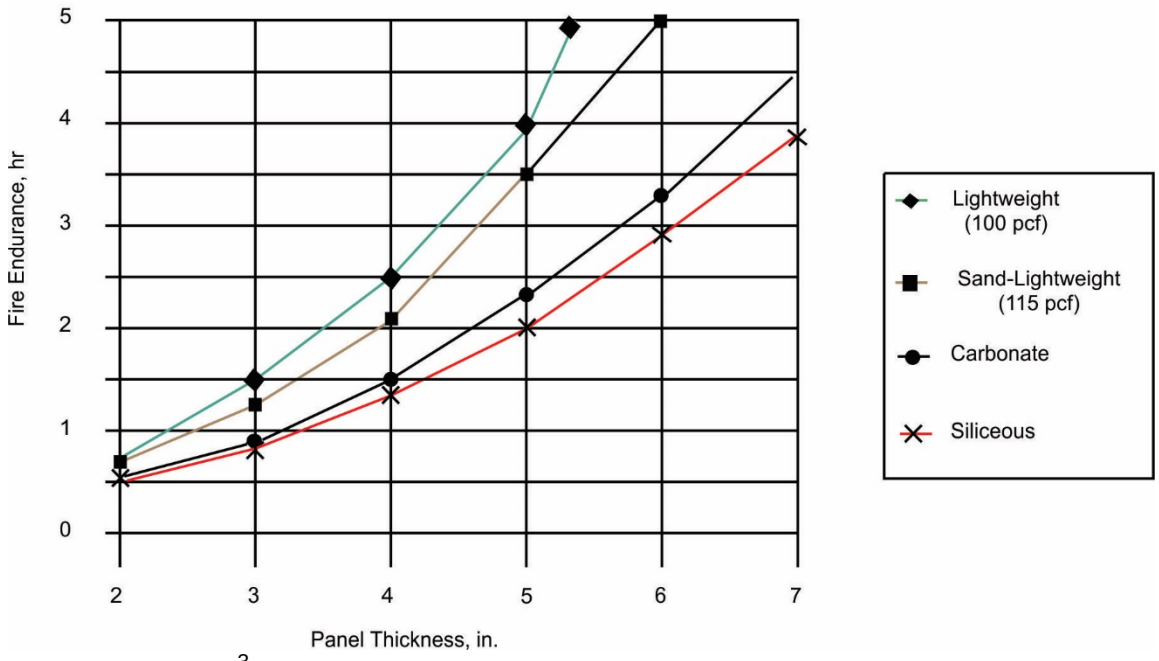
Fire barriers have from 2 h – 3 h fire resistance. The wall extends from the floor to the bottom side of the roof or floor deck, or from the floor to a fire resistance rated floor-ceiling assembly of equal fire rating.

Fire Partitions

Fire partitions have from 1 h – 2 h fire resistance, extend from the floor to the ceiling, but in all other respects are similar to fire barriers.

Design Features

Construct fire walls, fire barriers and fire partitions with material that has been tested and rated in accordance with ASTM E119, ISO 834-1, EN 1363-1, or AS/NZ 1530.



SI Units: 1 pcf=16.02 kg/m^3; 1 in.=25.4 mm

Figure 1. Concrete Thickness vs. Fire Endurance.

Concrete walls constructed with various aggregates have already been tested. Figure 1 shows the fire resistance rating of concrete walls constructed with various aggregates at various thicknesses.

Design fire walls as freestanding, tied or double fire walls. The fire wall must:

- Be designed as nonloadbearing. The structural framing in a tied fire wall can be loadbearing; however, the wall material must not carry any loads.
- Be constructed with Type M or S mortar using full bed mortaring when concrete blocks are used. Type M mortar contains no more than 1 part Portland cement, not over 25% hydrated lime or lime putty (by cement volume) and not less than 2¼ and not more than 3½ parts clean sand. Type S mortar contains no more than 1 part Portland cement, not less 25% and not more than 50% hydrated lime or lime putty (by cement volume) and not less than 2¼ and not more than 3½ parts clean sand.

- Be designed, constructed and maintained with all openings protected with listed through-penetration systems, fire dampers or fire doors.
- Be designed, constructed and maintained with minimal amount of openings. The aggregate width of the openings must not exceed 25% of the total wall length.
- Be designed for a minimum uniform load of 5 psf (0.24 kPa) from either direction applied perpendicular to the face of the wall. Design the wall and parapet for wind loading in accordance with local building design standards[1] and PRC.2.0.1.1. In areas prone to earthquakes, design for earthquake loading in accordance with local building design standards[2] and PRC.2.0.9. Submit drawings and calculations with a registered civil/structural engineer's stamp to the local AXA XL Risk Consulting Plan Review Office.
- Be designed and constructed to remain stable after collapse of the structure on either side of the wall or expansion or collapse of material stored near the wall.
- Be constructed with expansion, seismic and control joints a maximum every 150 ft (45 m). Have joints filled with listed joint treatment systems.
- Be designed with clearances per NFPA 221, between freestanding wall and structural framework on either side, between tied walls and roof beams and girders, and between double walls.
- Have extension walls, end walls, angle walls in accordance with NFPA 221.
- Extend from exterior wall to exterior wall or from one standard fire wall to another standard fire wall.
- Extend continuously through all stories of the building, and through the roof to form a minimum 3 ft (0.9 m) parapet over the highest elevation.

Fire barriers and fire partitions do not require parapets, end walls or angle walls, and can be loadbearing. Fire barriers and fire partitions must:

- Be designed for a minimum uniform load of 5 psf (0.24 kPa) from either direction applied perpendicular to the face of the wall;
- Be constructed with expansion, seismic and control joints.

Opening Protection

Protect all openings with listed fire door assemblies tested in accordance with NFPA 252, UL 10B, BS 476:Part 20, ISO 834, AS 1530.4, or EN 1634-1. Install and maintain fire doors in accordance with NFPA 80 and PRC.2.2.2. **Protect conveyor openings with automatic closing, fire doors as indicated in NFPA 80. Water curtains are not acceptable substitutes for fire doors**.

Provide two listed, 3 h fire resistance rated fire doors on each side of an opening in a 4 h fire wall. Where double fire walls are installed, provide two fire doors, one on each side of the double wall. These double fire doors can be installed as indicated in Figure 2 or in a freestanding, fire-resistive vestibule as shown in Figure 3.

Design and install all penetrations with a steel sleeve that is 1 in. (25 mm) larger than the pipe or conduit. Seal all spaces between the sleeve and pipes, conduits or cables penetrating firewalls with through-penetration systems tested in accordance with ASTM E814, UL 1479, or EN 1366-3. Fill the hollow spaces of concrete blocks adjacent to the sleeve with concrete, mortar or grout.

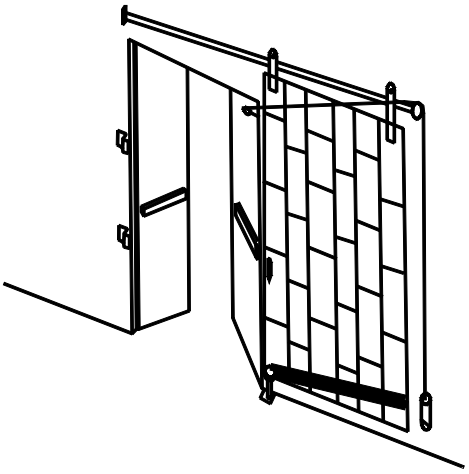


Figure 2. Two Fire Door Arrangement On A Fire Wall.

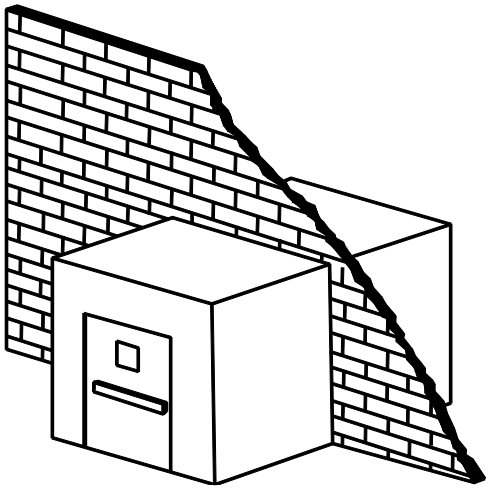


Figure 3. Vestibule Arrangement.

Reinforce the horizontal joints in concrete block walls immediately above and below the sleeve. Position pipes and conduits passing through the wall no closer than three times the largest pipe or conduit diameter.

Design and install all piping, wiring or cable trays penetrating fire walls no more than 3 ft (0.9 m) from the floor. If the structural framework, including joists, beams and girders, has a fire resistance equal to that of the wall, the penetration may be at any level in the wall.

Design and install ductwork with two listed, 3 h fire resistance rated, fire dampers one on each side of a 4 h fire wall. Provide slip joints between the ductwork and the damper sleeve.

More detailed information on opening protection, maintenance and testing is found in NFPA 80 and PRC.2.2.2.

DISCUSSION

Wall openings

Openings are the greatest weaknesses of fire walls. Every opening increases the possibility of fire spreading beyond or through the wall. No fire wall, regardless of its fire rating, will reliably protect against fire spread if openings are unprotected or the opening protection is poorly maintained.

A fire wall should be considered the last line of defense against fire spread. Only when automatic sprinklers are not effective in controlling a fire will the fire wall is needed. If sprinklers are impaired or otherwise rendered ineffective, waterspray will be similarly affected. For this reason, AXA XL Risk Consulting does not recommend waterspray for opening protection.

Parapet

The fire wall must extend from the floor through the roof to form a parapet. A parapet tops off the fire wall as an extension of it above the roof line and prevents a roof fire from spreading across the fire wall. Generally, parapet height should be at least 30 in. (0.76 m) above the highest roof or structure within 25 ft (7.6 m) of the fire wall.

Extension Wall

An extension wall is an extension of the fire wall beyond the exterior wall where the exterior and fire walls meet. An extension wall may be substituted for an end wall. (Refer to Figure 4.)

End Wall

An end wall (or wing wall) is a blank masonry exterior wall that meets an interior fire wall at right angles to form a T-shaped juncture. End walls may be required if the exterior walls could fail early in the fire due to their combustibility or method of securement to the building structure. They are designed to prevent the fire from passing around or through the walls. The length of the end wall depends on the wall height. See NFPA 221 for the specific requirements. (Refer to Figure 4.)

Angle Wall

Where the two exterior walls of two buildings meet to form an L-shaped juncture at the interior fire wall, construct an angle wall, consisting of a blank wall rated at most 1 h less than the fire wall. Extend the angle wall from the juncture out the required distance to prevent angle exposure. In addition, construct the exterior wall from the end of the angle wall out the required distance of noncombustible material. The length of the angle wall depends on the occupancy. See NFPA 221 for the specific requirements (Refer to Figure 4.)

Expansion and Control Joints

Expansion and control joints protect the wall against buckling due to expansion caused by rising temperatures. Control joints allow for initial wall shrinkage. Joints must be filled with listed joint treatment systems.

Freestanding, Tied and Double Fire Walls

Three basic fire walls available for modern building constructions are the freestanding fire wall also known as a cantilever wall, tied wall and double fire wall.

A freestanding wall has no ties to the building framing. This self-supporting structure is constructed of listed brick, reinforced concrete, or listed concrete masonry blocks and is connected to its footing with reinforcing bars. The wall is usually installed in an expansion break in the building framing. It must rely on its own strength to overcome forces such as expansion caused by temperature differences inside and outside of the wall. (Refer to Figure 5.)

To give walls added strength, reinforcing rods or pilasters are installed. A pilaster is a vertical structure protruding from a wall, consisting of a base and a top support. Reinforced pilasters should be spaced no more than 20 ft (6.1 m) on center. (Refer to Figure 6.)

Nonreinforced pilasters or pilasters constructed on one side will only support a nonreinforced 12 in. (305 mm) concrete block wall to 15 ft (4.6 m). Pilasters can be reinforced with steel rods up to approximately 30 ft (9.2 m). For higher walls, the pilasters require a steel column originating from deep footings or pilings.

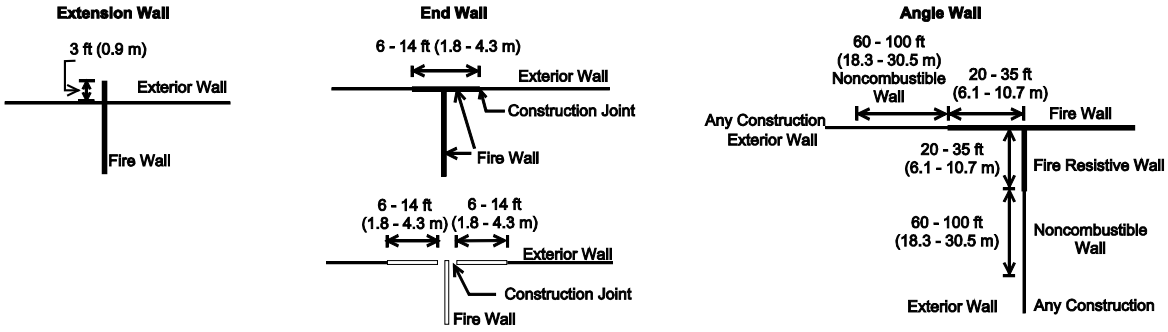


Figure 4. Extension Walls, End Walls And Angle Walls.

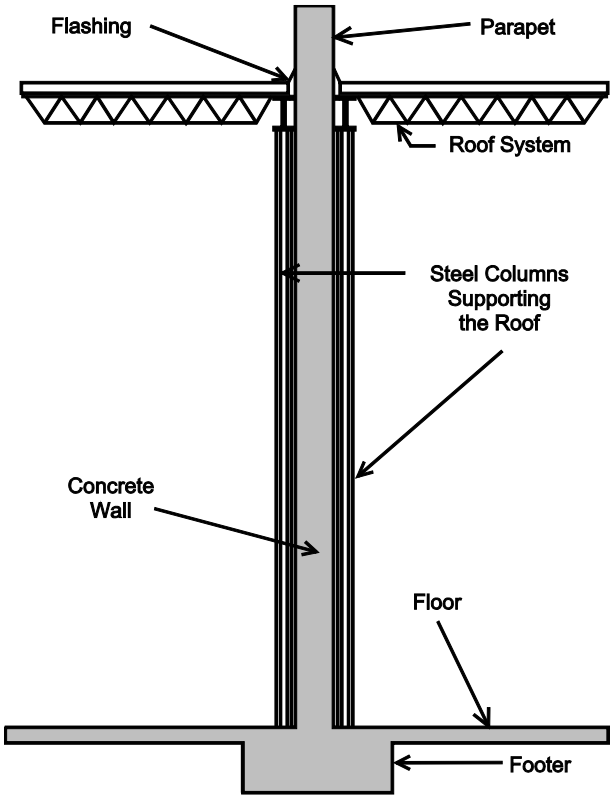


Figure 5. Freestanding Fire Wall.

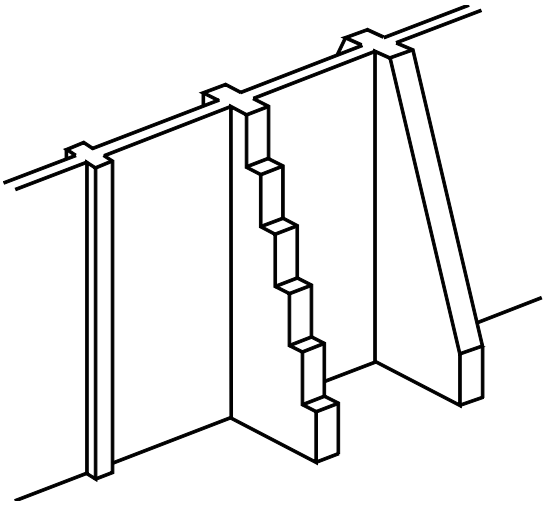


Figure 6. Pilasters Supporting A Fire Wall.

A tied fire wall is a wall erected to encase the steel framing or tied to the steel framing that is coated with a fireproofing material. The wall is held in place by the steel columns that support the roof system. (Refer to Figure 7). To maintain its stability, the roof steel on either side must be strong enough to resist forces caused by steel collapsing on a fire-exposed side. This stability is usually accomplished by having through-ties attached to the web on the beams and pass through the wall.

A double one-way fire wall consists of two one-way walls back-to-back with a separation between them. The separation distance is based on NFPA 221. Each wall must have at least 3 h fire resistance (Refer to Figure 8.) The double fire wall is more commonly found in new construction where a fire wall between an existing structure and a new building is required. The existing wall, secured to the existing building frame, could be upgraded to the required fire resistance rating. Then the new rated fire wall could be raised next to it and secured to the new building frame. If a fire on one side of the wall causes the loss of one wall, the wall supported by the other side should remain standing.

Nonrated metal panel walls can be reinforced by adding listed 3 h fire rated metal panels. Tilt-up concrete and masonry walls can usually be reinforced to provide a specified fire resistance rating.

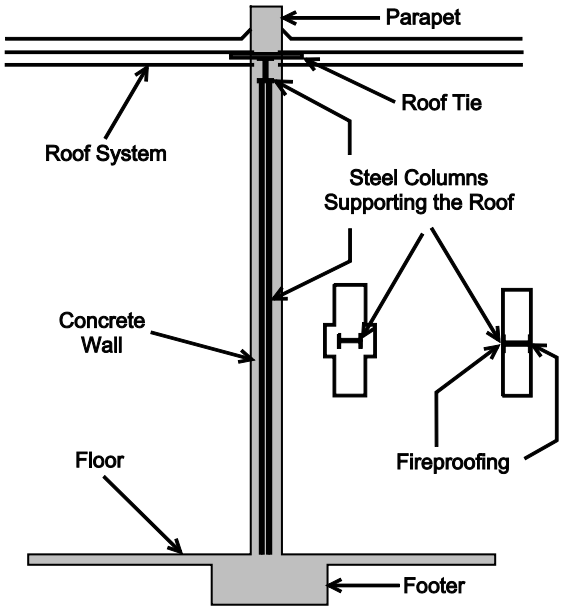


Figure 7. Tied Fire Wall.

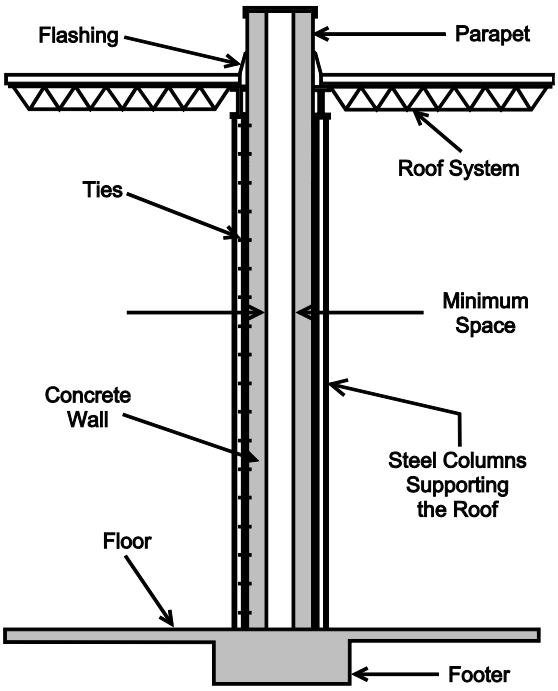


Figure 8. Double One Way Fire Wall.

Fire Barriers and Fire Partitions

The fire barrier or partition restricts the initial flow of heat to the area of origin, limits the unnecessary operation of sprinklers outside the fire zone, and provides sufficient time to coordinate and begin manual firefighting efforts from adjacent areas. However, fire barriers are most effective when heat and smoke vents are provided and sprinklers are in service. (Refer to Figures 9 and 10).

The difference between a fire barrier and fire partition is that fire barriers have higher ratings and extend from the floor to the underside of the floor system of the story above, or to the roof deck system. Fire partitions provide minimum fire protection, extend to the ceiling only, and are constructed of less fire resistive materials than fire barriers. Although the terms barrier and partition have been used interchangeably, AXA XL Risk Consulting makes a distinction between the two.

Multistory fire barriers could be attached to and supported by structural members having fire resistance at least equal to that of the fire barrier. If sprinkler protection is adequate for the occupancy, the fire barrier should not be breached, even if one or two sprinkler heads do not operate.

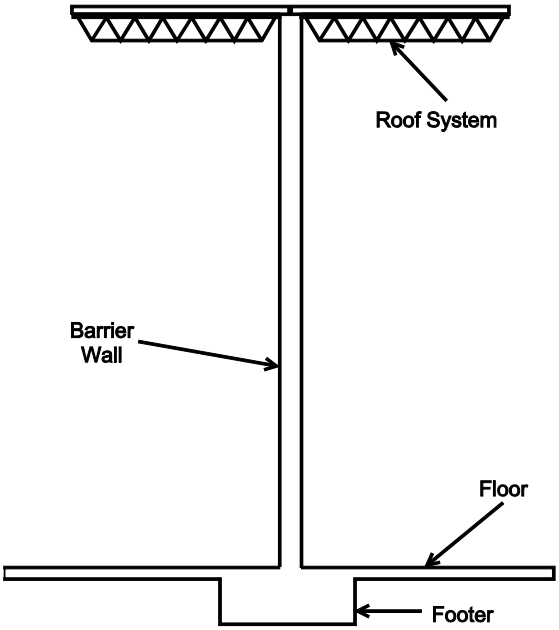


Figure 9. Fire Barrier From Floor To Roof Deck.

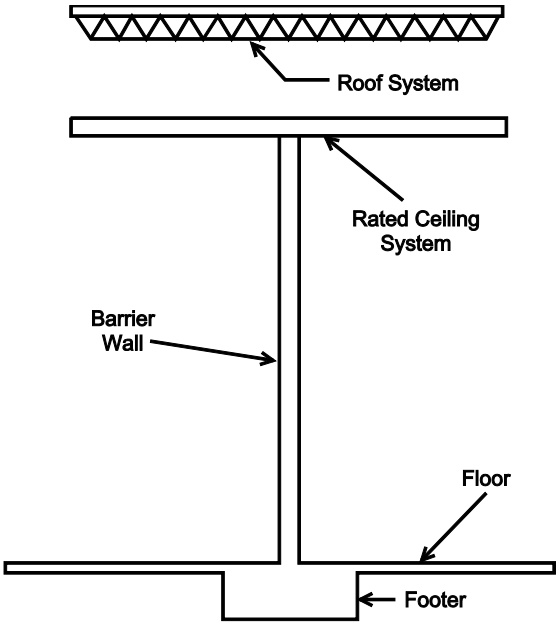


Figure 10. Fire Barrier From Floor To Rated Ceiling.

A **one-way fire barrier**, the simplest of the fire barriers, is designed to withstand a fire on one side only. It is effective for separating a high value occupancy with low combustible loading from a higher hazard occupancy, and is tied into the steel or other framework on the low hazard side.

A one-way fire barrier should be a nonloadbearing wall:

- Attached to the steel framing of the building.
- Attached to or installed in a single column line with through-barrier ties to building framing on both sides.
- Installed to follow the column line so it can benefit from the vertical strength of the column and resist twisting forces as much as possible. All columns and trusses parallel to and within 1 ft (0.3 m) of the barrier should have the same fire resistance rating as the barrier.

When building bays on either side of the barrier have unequal strength, the lateral resistance of the frame on either side must resist horizontal forces.

Where two buildings are joined with a barrier or where the same building is separated into two sections by a barrier, each side of the building must be balanced for stability. The barrier should be tied to its framing at the same level on both sides, and the columns should be located and reinforced so that the symmetry of the building is not distorted. There must be sufficient lateral resistance of the continuous steel frame on either side of the barrier to resist horizontal forces on either side. Horizontal forces should be calculated by a licensed professional engineer.

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