PDHonline Course G125 (1 PDH)

Understanding Firewall Basics

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Understanding Firewall Basics

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Firewall Definition:

A fire-resistant, rated wall having protected 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 the collapse of the existing construction on either side of the wall to occur without allowing the collapse of the wall.

Source: Manitoba Masonry Contractor's Association

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General:

Firewalls are necessary for two primary reasons and are typically required by national, state and local safety codes. Information about the type of fire-control walls for various occupancies can be found in the Building Codes, NFPA Code and from an Industrial Risk Insurer.

1. Contain fires and subsequently limit property damage.
2. Protect the building occupants.

Source: ACP Concrete Ltd

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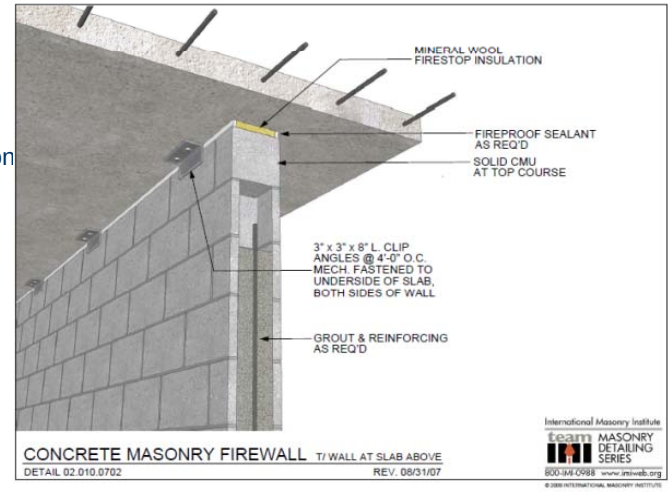
For this course, four types of walls will be defined. The types of firewalls are differentiated by their construction and by their rated ability to resist a fire. In other words a firewall is primarily categorized by how well and how long it is able to withstand a fire.

1. Standard Firewall
2. Firewall
3. Fire Barrier
4. Fire Partition



Source: International Masonry Institute

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Firewalls should be designed and built with materials that have met the requirements of ASTM E 119 (Standard Method of Fire Testing of Building Construction and Materials). ASTM E 119 specifies the required instructions for fire-endurance tests, which include placing a sample of a firewall in a furnace and heating it to a certain temperature for a specified length of time. Data collected during the test includes the length of time for which the wall remains structurally intact and the ability of the wall to limit the amount of heat passing through it.

Source: Concord Construction Company

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A firewall is designed to remain freestanding even if the adjacent structure collapses. To withstand the expansion of the adjacent structure that accompanies the heat generated by a fire, firewalls are usually thicker than walls that are intended to act as fire stops only. If a firewall is of considerable height and length, buttresses or pilasters may be required to provide adequate lateral stability.

Source: Yale University

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Fire stops, fire barriers and fire partitions can be used to sub-divide portions of the building contained by a firewall. These types of walls can be attached to or supported by the adjacent structure. These lower rated walls must also be built according to designs established by nationally recognized testing laboratories. Some firewalls, which border areas containing explosive materials, must also resist the expansive lateral pressures that can result from the explosion of these types of materials. Blast resisting walls require specialized engineered designs and are beyond the scope of this webinar.

Source: SIV Fire Protection Ltd

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Most firewalls, as previously indicated, are built to standards established by recognized testing laboratories. These designs only establish fire rating (i.e., how long a wall can withstand fire). There are other factors that should be taken into account when designing a firewall and include the following:

- Stability under applied design loadings: Superimposed dead loads such as heavy equipment or piping hanging from the wall. Live loads such as wind, snow and earthquake forces acting on the wall.
- Other forces affecting the wall: Collapse of the adjacent roof structure or adjoining buildings, building contents (such as elevated vessels or racks) or explosion of the building contents (such as pressure vessels or flammable materials).
- Effects of the thermal expansion on the adjacent structural steel or the wall itself: This depends upon the length of the framing and the height of the steel columns, while the effects of the wall itself depend upon the construction material, height and width of the wall.

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Standard Firewall:

A standard firewall is a freestanding masonry or concrete wall with no openings (see Figure 1). It can be designed to have as much as a 4-hour fire-resistance rating. The standard firewall is designed to contain a fire within the area of origin, even after other firefighting efforts, such as sprinklers, have failed.

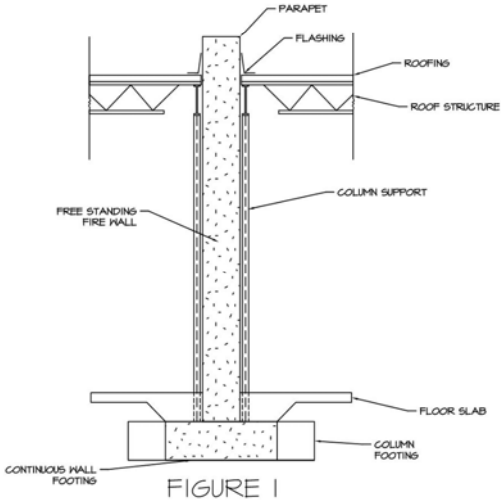

FIGURE 1

In addition, a standard firewall must:

1. Be designed to withstand damage from the fall, collapse or expansion of stored items or the adjacent structure.
2. Resist fracture, penetration and fragmentation that can be caused by a fire.
3. Extend from exterior wall to exterior wall, or from one standard firewall to another. If the exterior wall is rated less than 1-hour and or does not extend at least 4-feet horizontally on both sides of the fire wall, then the fire wall must extend at least 18-inches beyond the exterior wall per IBC Section 706.5
4. Extend vertically and continuously through all stories of the building and through the roof to form a parapet over the highest point in the roof or of any structure within a specified distance of the firewall.
5. Have expansion or control joints, which help prevent the wall from buckling when rising temperatures cause the wall to expand.

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6. Have a wing wall of a specified minimum length, an end wall of a specified minimum length or an extension wall as needed (see Figure 2).

End walls or wing walls are blank masonry or concrete structures (i.e., having no openings) that prevent a fire from passing around or through the adjacent firewalls. These same walls are joined perpendicularly to the ends of the firewall, forming part of the building's exterior walls as indicated in Figure 2.

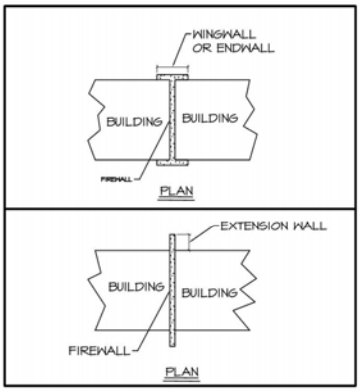

FIGURE 2

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Where two buildings meet perpendicularly to form an L-shape (as illustrated in Figure 3), an end wall is appended to an interior firewall to extend beyond the inside corner of the L shape. It should be constructed of masonry, concrete or other fire-rated material. Extension walls can substitute for end walls or wing walls. A wall extension must project in line with the firewall a minimum distance beyond the building's exterior walls.

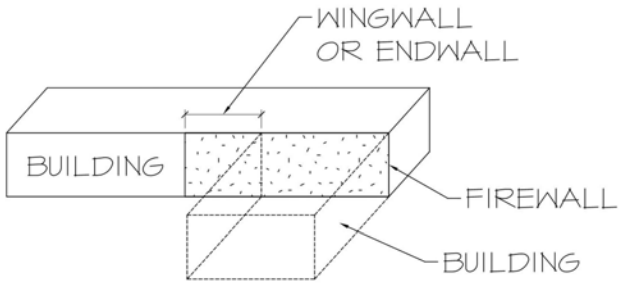

FIGURE 3

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A firewall is similar to a standard firewall, but has protected openings and can have up to a 3 or 4-hour fire-resistance rating. This classification also includes tied walls and double one-way walls, which will be discussed later.

Source: KD Construction, Inc.

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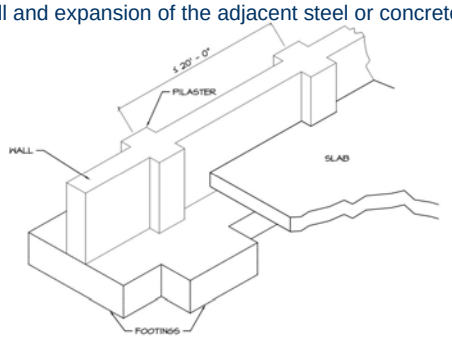
There are several types of firewalls and standard firewalls and include:

Freestanding or Cantilevered Firewalls: This type of firewall has no ties to the building other than flashing at the roof as required to prevent moisture intrusion into the building. This type of firewall can be constructed of brick, concrete or concrete masonry units. This type of wall is usually located at a building expansion joint. A freestanding firewall must be designed to independently resist forces such as expansion caused by temperature differences on either side of the wall or collapse of the building components or contents. Typically a freestanding wall is strengthened internally with reinforcement, or pilasters may be used to provide the required strength (as indicated in Figure 4). Proper horizontal clearance between the wall and the structural framework must be maintained to allow for the deflection of the wall and expansion of the adjacent steel or concrete framing.



MASONRY CANTILEVER WALL WITH PILASTERS

FIGURE 4

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As indicated in the previous slide, steel framing on the fire side of the wall will expand and may cause failure of the wall particularly when steel on each side of the wall does not line up horizontally or vertically (see Figure 5A). Adequate clearance between the wall and steel on both sides is needed to allow for the framing on the fireside to reach the point of maximum expansion without exerting any lateral force on the firewall (see Figure 5B).

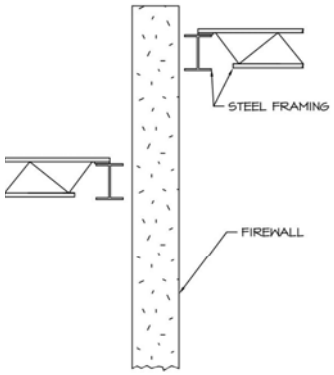

FIGURE 5A

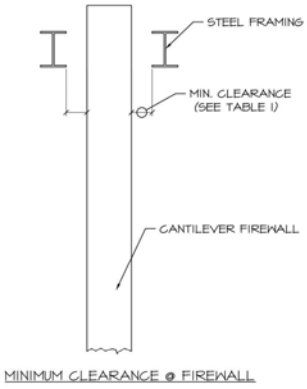

FIGURE 5B

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Freestanding Firewall Recommendations:

1. Cantilever walls should be designed for a maximum uniform lateral load of 5 PSF from either side to assure reasonable stability.
2. Cantilever walls should be securely fixed to their foundation to resist the moment due to the 5 PSF lateral load. This may be accomplished by reinforcement extending from the footing into the wall to resist the cantilever moment. The soil and concrete floor slab can be utilized to develop the resisting moment needed at the footing.
3. Cantilever walls are not recommended in seismic areas. If used, they should be specifically designed to resist the anticipated earthquake forces.

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4. To prevent damage during initial steel expansion, clearance (see Table 1) should be provided between the wall and the steel framing on each side of the cantilever walls.

Table 1

Recommended Clearance Between Structural Steel and Firewall

Length of Bay Perpendicular to the Firewall	Minimum Clearance Between Wall and Steel
20'-0"	2½ inches
25'-0"	3¼ inches
30'-0"	3¾ inches
35'-0"	4½ inches
40'-0"	5 inches
45'-0"	5¾ inches
50'-0"	6¼ inches
55'-0"	7 inches
60'-0" or greater	7½ inches

The recommendations provided in Table 1 are based on Factory Mutual (FM) requirements for MFL (Maximum Foreseeable Loss) firewalls.

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Alternately a solid masonry or concrete pilaster or corbel (see Figure 6) can be constructed between the wall and structural steel. A layer of building paper should be placed over the structural steel to prevent bonding to it. If clearance is needed for normal building expansion, a small space can be maintained between the column and the pilaster or corbel. Per FM, the pilaster or corbel should be at least 2'-0" wide. Corbels should be at least as high on each face as the adjacent primary structural steel member but the face abutting the walls should be no less than 2'-0". In addition, per FM, pilasters or corbels are not needed on walls up to 40'-0" if the wall is a maximum of ¾"from the structural framework.

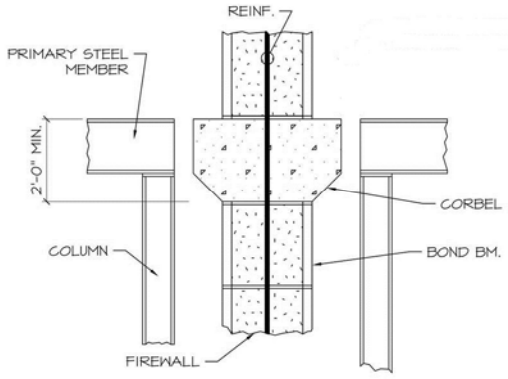

FIGURE 6

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Per FM, for walls higher than 40'-0", this maximum space may be increased ¼" for every additional 10'-0" of wall height (see Figure 7). The space between the corbels or pilasters and adjacent framework should not exceed the previously stated guidelines. A bond beam should be installed in the second course below the bottom of the primary steel and all cores of concrete block above should be filled with concrete. If the primary steel is parallel to the firewall and the secondary steel (which would in that case be perpendicular to the wall) consists of hot-rolled structural shapes, the bond beam and grouted cores above should extend the entire length of the structure. Otherwise, the bond beam and grouted cores need only extend 1'-0"on each side of the columns. A steel assembly can be used in lieu of a corbel; however, it should be designed to withstand the load due to the steel frame expanding without crushing wall.

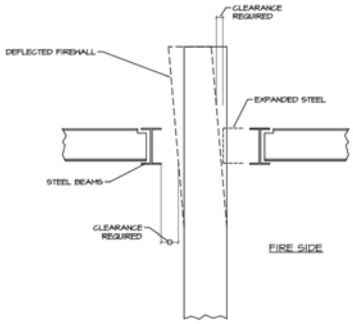

FIGURE 7

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5. If tilt-up or precast concrete construction is used in a cantilever wall design, particular attention should be paid to the connection to the footing or pilasters such that it can adequately resist the overturning moment and maintain a 4-hour fire resistance.

6. Future cantilever firewalls used as temporary exterior walls (until future construction occurs) are exposed to wind and therefore should be fastened to the building frame until the additional building is built or designed to be self-supporting. Care should then be taken to assure that all ties to the wall are completely cut when new construction is applied if the wall is not designed as a cantilever for the temporary wind exposure.

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Tied Firewalls:

This type of firewall consists of masonry or other rated construction materials that either encases or is tied to the structural framing (see Figure 8A & 8B). These types of walls are integral with and therefore supported by the structural framework. To assure the stability of the wall, the adjacent structural framing on either side of the wall must be designed to resist the forces caused by the structure collapsing on the oppo

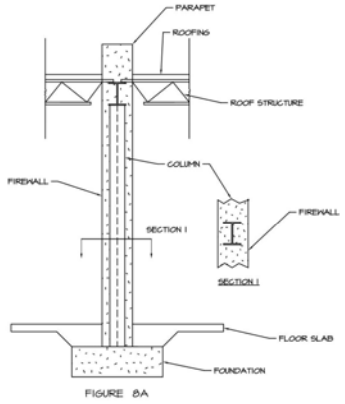

FIGURE 8A

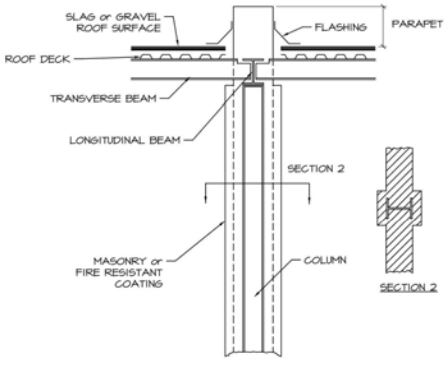

FIGURE 8B

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To remain stable, the pull of the collapsing steel on the fire side of the wall must be resisted by the strength of the unheated steel on the other side. Since the fire can occur on either side of the wall, the wall preferably should be located at the center of strength of the building frame or in other words the area of the building in which the steel framing on either side has equal lateral resistance. In small structures, the center of strength generally is in the middle of the building frame (see Figure 9A). If the firewall cannot be located in the middle of the building then strengthening of the smaller remaining portion of the building as shown in Figure 9B may be required.

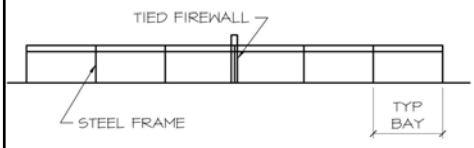

FIGURE 9A

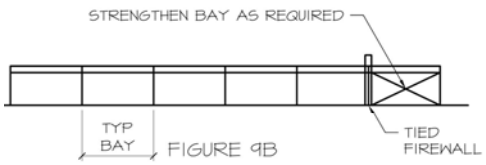

FIGURE 9B

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Tied Firewall Recommendations:

1. A tied wall should follow a column line to take advantage of the vertical strength of the column and to minimize twisting forces on the wall. The steel columns and roof framing in line with the wall should have fire resistance equal to the wall. For situations where the wall is constructed between columns on a double-column line, the column and beams parallel to the wall immediately on each side should be rated to a fire resistance equal to the wall to prevent the steel from buckling and fracturing the wall.
2. The steel framing on each side of a tied firewall should be at the same elevation an in line horizontally.

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3. When the steel frames on either side of the wall are not of equivalent strength provisions must be made so that the lateral resistance of the frame on either side of the wall is sufficient to resist the horizontal component of the force resulting from collapsing steel on the opposite side. The horizontal force may be computed by using the following formula;

$$H = (WL^2)/(8S)$$

Where: H = Horizontal pull in pounds
W = Dead load of the roof per structure, pounds per foot. (In some conditions, such as when ponding of rainwater or snow is anticipated, W should also include live load)
L = Truss or beam span in feet.
S = Sag in feet that may be assumed as:

0.07L for open-web steel joists
0.09L for solid-web steel beams

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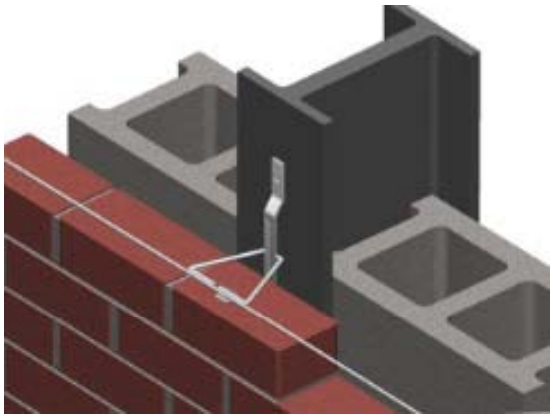
4. At the roof level, the expected horizontal pull should be transmitted through the wall with continuous steel framing (for single column line tied walls) or through wall ties (for double-column line tied walls). Masonry anchors from the wall to the respective framework on each side will not provide an adequate tie.



Source: TAMLYN

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5. Where the wall is constructed between columns on a double column line, the ties should be designed based on the formula above using an allowable stress of 70 psi. Two tie rods per column should be used to reduce torsion (see Figure 10A) when the primary steel is perpendicular to the wall. The ties should be connected to the roof framing steel over the columns. When the primary steel is parallel to the wall it may be necessary to install ties more often than every column line (see Figure 10B). Nuts for through wall ties should be backed off slightly (up to ¾ inch) for walls up to 40'-0" high with an additional ¼ inch added for every addition 10'-0" of wall height to allow for normal building movement. While through wall connections should be used to make steel framework continuous across the wall, flexible masonry anchors should be provided to brace the wall laterally. Enough slack should be provided in the anchors to compensate for the slack in the through wall ties. This is to prevent the collapsing steel from pulling on the wall before there is resistance from the steel on the unexposed side.

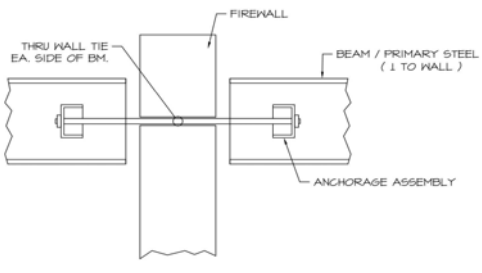

FIGURE 10A

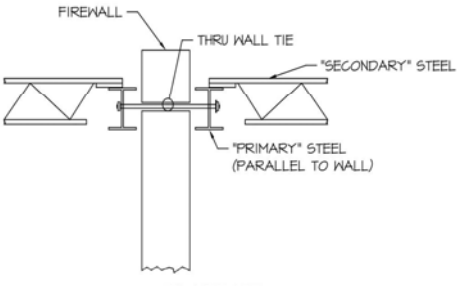

FIGURE 10B

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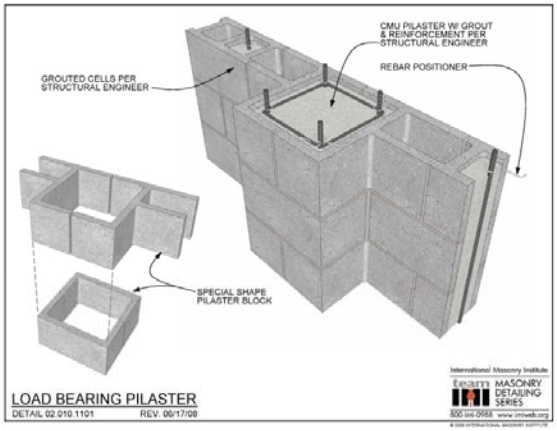
6. To prevent damage during initial steel expansion to double-column line, tied firewalls clearance should be provided between the wall and the steel framing on each side of the wall (see Table 1). As an alternative it is acceptable to construct solid masonry or concrete pilasters or corbels between the wall and structural steel similar to that recommended for freestanding firewalls.



Source: International Masonry Institute

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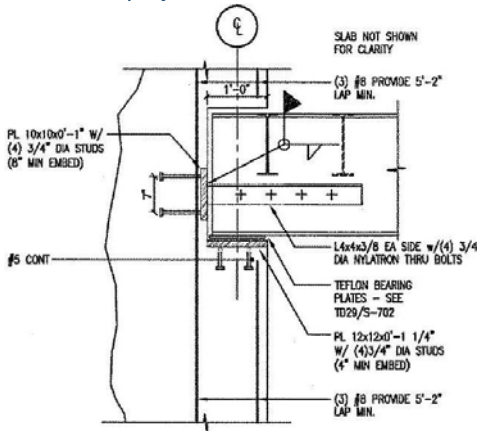
7. In the case of single-column line tied walls, the framing on the unexposed side of the wall will resist steel expansion on the fire side. However, the connection of the wall to the columns should allow some flexibility as the building frame on the unexposed side will deflect laterally as a result of the pull from the sagging steel on the fire side. This can be accomplished by using flexible masonry anchors or using concrete blocks that loosely key into the re-entrant space of the column. If sprayed-on fireproofing is used, the entire column should be sprayed before the wall is constructed.



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Double One-Way Firewalls:

This type of wall includes two one-way rated firewalls (see Figure 11), which have exposed structural framing on one side. The one-way walls are placed back-to-back, with a minimum separation between them. Each wall must have a minimum fire resistance rating of 3-hours. Double firewalls are most commonly built when a firewall is required to separate an existing structure from a new building. In such a situation it is possible to upgrade a wall secured to an existing building frame to the required fire-resistance rating. This is accomplished by constructing a new rated firewall next to it and securing it to the new building frame. If a fire destroys one wall, the wall supported by the other side should remain standing.

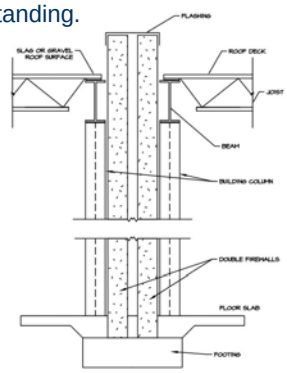

FIGURE 11

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Double One-way Recommendations:

1. Each of the two wall elements should have a 3-hour fire resistance rating.

2. If significant separation to prevent bonding of masonry walls is lacking, a layer of building paper or other suitable material should be used between the walls.

3. Each wall should be anchored to its respective steel framework at the roof level. There should be no connections other than the roof flashing between the walls. Particular attention should be paid to details at openings in the walls and at the roof flashing between the walls.

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4. To prevent damage to the remaining wall during initial steel expansion resulting from the extreme heat of the fire, clearance (according to Table 1) should be provided between the walls (see Figure 12A). As an alternative it is acceptable to construct solid masonry or concrete pilasters or corbels between the wall and structural steel similar to that recommended for freestanding firewalls (see Figure 12B).

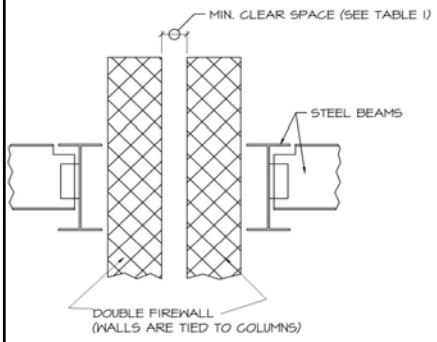

FIGURE 12A

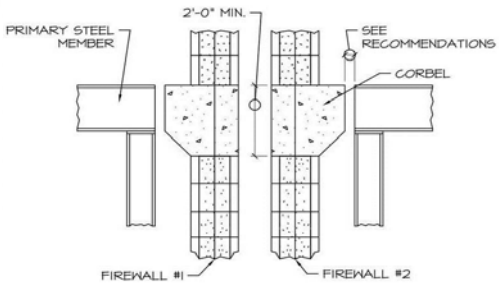

FIGURE 12B

Fire Barriers:

Fire barriers typically have lower fire-resistance ratings than firewalls, however, fire barriers must also be designed and constructed according to specifications established by nationally recognized laboratories. Fire barriers are typically used to subdivide floors and can be attached to or supported by structural members. Fire barriers, which are typically rated for 2 to 3-hour fire-resistance, are usually non-load-bearing walls that extend from the floor-to-floor or floor-to-roof. All supporting structures, such as roofs, columns or floors, should be noncombustible or fire resistant to a rating similar to the barriers they support.

Source: Envirograf

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Fire barriers do not require parapets or end walls, and are generally not freestanding. Fire barriers restrict the initial flow of heat within the area of origin and thereby help to limit the actuation of sprinklers outside the fire zone. Fire barriers also help to provide the building occupants with sufficient time to evacuate to adjacent safe areas. Fire barriers are most effective when heat and smoke vents are provided and sprinklers are operable. A fire barrier helps to supplement the sprinkler system. For example, a sprinkler system might be adequate for the area it protects. However, during a fire one or two sprinkler heads might malfunction due to lack of maintenance or a mechanical problem. In this situation, the fire barrier helps to contain the fire in the absence of a fully functioning sprinkler system.

Source: Envirograf

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If there is a possibility of an intense fire on either side of a barrier, a double or freestanding barrier can be constructed between a building's structural columns. A double barrier is similar to a double one-way wall, but instead is comprised of two, one-way fire barriers rather than two fire walls. A one-way fire barrier is the simplest form of a fire barrier. It is designed to withstand a fire on one side only. It is effective for separating an area whose contents will generate relatively little heat during a fire from a higher-hazard area. This type of fire barrier is tied into the building's structural framing on the low-hazard side of the wall.

Source: Firewise Supplies Ltd

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A one-way fire barrier should be a non-loadbearing wall and be installed in line with a row of the building's structural columns and have through-barrier ties to the building frame on both sides of the wall. Constructing a fire barrier to follow a line of structural columns allows it to benefit from the columns' vertical strength. All columns and structural framing parallel to and within 1'-0" of the barrier should have the same fire-resistance rating as the barrier. Where two buildings are joined with a barrier, each side of the building must be designed to provide stability. That is, the structural steel must be constructed to support all loads in the presence of a fire or absence of the structure on the opposite side of the wall.

Source: SSA Techno Construction Pvt. Ltd.

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Fire Partitions:

Fire partitions subdivide areas within a building and can be attached to and supported by adjacent structural members. Fire partitions extend to the ceiling only and are constructed of less fire-resistive materials than fire barriers. However, they too must be built according to specifications certified by nationally recognized testing laboratories. The terms barrier and partition are generally used interchangeably in the industry. However, there is a difference between the two structures. Fire partitions typically only have a 1 to 2-hour fire-resistance rating. In all other respects, they are similar to fire barriers.

Source: Warrington Certification Ltd

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Protection at Openings:

The biggest cause of firewall failure is unprotected or improperly protected openings at doorways, conveyors and other similar penetrations. These types of openings in firewalls have resulted in the spread of some of the most destructive industrial fires in history. To maintain the integrity of a wall and to keep fires from spreading, the number and size of openings in a firewall should be minimized. In general, openings should not constitute more than 25% of the area of any firewall and should be constructed with the proper protection.

Source: NIST

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All openings in firewalls and fire barriers should be protected with equipment listed by the national testing laboratories. Opening protection components include automatic fire doors, shutters or dampers, deluge sprinkler systems and fire-stop assemblies. Opening protection should have a fire-resistance rating equal to or greater than the walls in which they are installed. Manually operated doors, windows, shutters or water curtains are not viable means of protecting openings in firewalls or fire barriers.

Source: J.W. Murdoch & Sons

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Fire door assemblies should be listed by a nationally recognized laboratory. The listing should be based on tests performed in accordance with The Standard Methods of Fire Tests for Door Assemblies from ASTM E152, UL10B or NFPA 252. These tests, similar to the test methods for firewalls, involve placing a sample of a fire door in a furnace and rating its endurance. These tests are not usually performed on doors larger than 120 square feet; therefore, if an oversized door is required, the type selected should be certified and labeled as an "oversized door".

Source: ACME Doorway Technical Services

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Fire doors should be simple, direct acting, and reliable. When selecting a design, be sure the product complies with the following:

1. Self-releasing features are incorporated into the design of the track, chain supports and other components.

2. Sprinkler discharge will not impede operation of any fusible link on the fire door. A fusible link, which consists of two pieces of metal soldered together, is typically installed on a fire door, holding the door open. When the ambient temperature in the area reaches a certain level, the solder melts allowing the door to close.

3. If a conveyor belt carries objects though an opening protected by a fire door, counterweights, springs and other components must be designed with enough strength to push the materials on the conveyor belt out of the way, allowing the fire door to close

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Per NFPA Section 4.6, fire doors are rated at 4, 3, 1½ and 1-hours, as well as 45, 30 and 20 minutes. Fire doors are also rated at levels that indicate the maximum temperature that can be transmitted to the unexposed side after 30 minutes. Three levels of temperatures are typically provided for this type of rating and include; up to 250 degrees Fahrenheit, up to 450 degrees Fahrenheit and up to 650 degrees Fahrenheit. The lower the temperature rating, the more protection the door provides, since it conveys less heat than a door with a higher temperature rating. A fire door with a temperature transfer level higher than 250 degrees Fahrenheit may allow sufficient heat from one side to pass through enabling the ignition of combustible materials located on the other side of the door.

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Types of fire doors include; swinging, horizontally sliding, vertically sliding and rolling. Rolling doors are overhead metal doors that unroll downward to close. A door should be chosen depending upon how it will be used and what operational clearances it will require. Hardware is a critical part of the fire door. A door that does not operate properly in an emergency is as useless as no door at all. Booklets are available from the testing laboratories, which provide recommendations of specific hardware to be used with different types of doors. The hardware should be installed according to manufacturers' specifications.

Fire doors used for egress must be designed and installed in accordance with the requirements of the NFPA Life Safety Code. Single-personnel doors (i.e., doors that allow only one person at a time to pass) should not be larger than 3'-0" x 7'-0". Glass is allowed in ½-hour rated fire doors. Fire doors should be provided in all openings in firewalls and fire barriers. Protective devices such as bumpers, guards or bollards should be installed to prevent vehicular traffic from damaging the doors and their mechanisms and extend at least 60-inches above the finished floor level.

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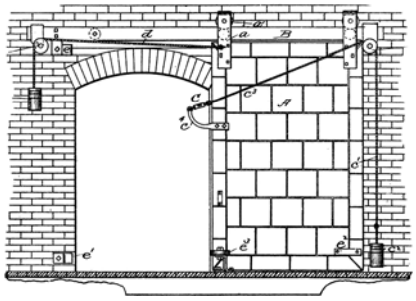
Closing Mechanisms:

Fire doors are arranged to close automatically via links with certain devices. The most common such device is the heat-sensitive fusible link. A fusible link is installed over a door opening and at the ceiling on both sides of the wall. When activated, the link releases a latch, which in turn releases the door or the counterweights that trigger the operation of the door. Another device is the fire detector. Fire detectors are located on each side of the wall, either over the opening or at the ceiling. When activated the detector releases the door or a set of weights that triggers the operation of the door. A third device is a fire-suppression system. This can be a sprinkler system, water-flow alarm, carbon dioxide system or foam system. When the system is activated, it automatically releases the fire door.



Source: The Official Gazette of the United States Patent Office

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Through Penetration Protection:

In firewalls or fire barriers, "through wall penetrations" that allow passage of cables, ducts, pipes and conduits also present problems. These types of openings should be sealed with noncombustible material having a fire-resistance rating equal to that of the wall. If an opening is no longer required, it should be permanently sealed. Be sure to include through penetrations when calculating whether openings in a firewall occupy 25% of its area.

Source: Fire Protection Supplies

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Ducts should be made of noncombustible materials and be constructed with automatically activated fire dampers where they pass through the firewall or fire barrier. A fire damper is a mechanism, placed in a duct that closes off the duct when the temperature reaches a certain level. Improperly designed ducts can cause problems. For example, during a fire, the structure can collapse, exerting pressure on a duct. If the duct is not designed to break free from the firewall, it can exert excessive pressure on the wall, enlarging the penetration and thereby allowing the fire to breach the wall. To avoid this scenario ducts, piping conduits and cable trays if possible should be installed around a wall.

If any of these types of components must pass through the wall, the penetration should be installed as near to the floor as possible and preferably as near as possible to other intersecting walls. Components passing through a wall more than 3'-0" above the floor should be designed to break away during a fire. Slip joints can be installed to allow ducts and cable trays to detach from the wall. A slip joint is a plastic sleeve that fits into an opening in a wall that in turn allows the two ends of the duct or cable tray to abut inside the sleeve.

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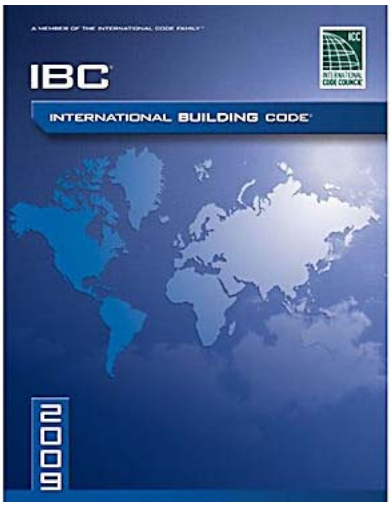
Per IBC Section 713.3.1 holes in concrete or masonry walls may be 6-inches in diameter and the area of the opening should not exceed 144 square inches. In addition, concrete, grout or other fire resistant material can be used to fill the annular space for the entire thickness of the wall, or as required to maintain the minimum fire resistance rating of the wall.



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Summary:

There are four types of walls that help mitigate the spread of fires and protect building occupants. These walls include firewalls, standard firewalls, fire barriers and fire partitions. A standard firewall must provide a minimum fire resistance rating of 4-hours. A firewall must provide a minimum fire resistance rating of either 3 or 4-hours. Fire barriers and fire partitions provide a minimum of 2 to 3-hours and 1 to 2-hours of fire resistance rating, respectively.

Ratings of Standard Firewalls, Firewalls, Barriers and Partitions		
Type of Construction	Rating	Configuration
Standard Firewall	4-hour minimum with no openings.	Parapet extends above the roof with wing walls, end walls or extensions.
Firewall	3 to 4-hour with protected openings.	Parapet extends above the roof with wing walls, end walls or extensions.
Fire Barrier	2 to 3-hour with protected openings.	Wall extends from floor to beneath roof or floor deck above.
Fire Partition	1 to 2-hour with protected openings.	Wall extends from floor to ceiling.

Openings in firewalls must also be constructed to satisfy the same minimum fire resistance rating as the wall in which they are located. Wall penetrations likewise must also provide a fire rating equal to or greater than the effected wall. Closing mechanisms for both protected wall openings and penetrations must be carefully scrutinized in order to insure the proper functioning of the equipment intended to prevent the breach of the firewall at the opening or penetration.

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Related Links:

For additional technical information related to this subject, please visit the following websites or web pages:

NFPA Codes and Standards
http://www.nfpa.org/

Underwriters Laboratories
http://www.ul.com/

FM Global
https://www.fmglobal.com/

- The End -

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