

Fire walls

The following information describes the function of and provides guidelines for the identification and use of fire walls and partitions. It briefly discusses walls required by building codes and walls for the separation of occupancies.

This document discusses in general terms the various construction types for fire walls and the fire resistance rating that can normally be expected. It does not give specific construction methods that can be used to achieve a specific fire rating. Underwriters Laboratories (UL) should be consulted to obtain specific construction materials and methods.

The terms “fire wall” and “fire partition” are interchangeable for the purpose of this document. In general, the term “fire partition” is sometimes used for barriers with two hours resistance or less, and “fire wall” is used for barriers with more than two hours resistance. This practice is not universal and an hourly rating should be attached to either term (e.g., a “one-hour fire partition” or a “one-hour fire wall”). For the sake of this document, the term “fire wall” will be used for both fire walls and fire partitions.

Fire walls and partitions are generally recommended as protection from either internal or external exposures. As such, they help limit fire spread, control the number of sprinklers that will open, and help to reduce smoke damage.

This document is intended to help the reader to identify fire walls and determine in general terms a range for the fire resistance of a wall.

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1. The hourly rating of recommended fire walls should be in accordance with tests conducted by a recognized independent laboratory in accordance with ASTM Specification E 119 (NFPA 251).
2. Fire walls should be stable for the entire time that they are expected to endure the fire exposure (the wall's hourly fire resistance rating). This stability is dependent upon the structural frame that supports the wall (if applicable). If the frame is to be exposed to the fire, then either a fire resistive frame (i.e., concrete, protected steel) or a steel frame protected by automatic sprinkler protection should be used. In certain high hazard occupancies, additional sprinklers (in conjunction with the ceiling sprinklers) may be needed to protect the steel frame. If a fire-resistive frame is used, its hourly rating should be equal to, or higher than, that of the wall.
3. Penetrations in fire walls should not reduce the integrity of the wall as a heat and smoke barrier. All pipe and conduit penetrations should have a steel sleeve and then be sealed with an approved wall and floor penetration fire stop with an equal or greater hourly rating than the wall. Penetrations for cable trays, ducts and cable not in conduit do not need to be sleeved; however, these penetrations do need to be sealed as noted above.
4. Openings in fire walls should be protected by UL listed fire doors of the proper fire rating.
5. The use of windows in a fire subdivision should be avoided whenever practical. When windows are considered necessary, they should have a fire rating consistent with the rating of the subdivision. Listed wired glass with a minimum thickness of $\frac{1}{4}$ in. or other listed fire-rated glass should be used. Individual units should not exceed a maximum area of 1296 sq. in. and a maximum dimension of 54 in. An approved or listed frame should be used. The maximum glass area per unit wall area should not exceed the limits of the listing. When plain glass is used or the windows do not have a fire rating consistent with the subdivision, an automatic closing fire door or shutter of suitable fire rating should be installed to protect the window.
6. When using fire walls to separate occupancies such as rooms containing flammable liquids; curbs, ramps and/or drainage trenches should be provided at openings in the wall. Fire doors or water spray will normally not prevent the spread of flammable liquids or other flowing material through an opening in a fire wall

Rating by wall construction

Precast concrete walls

Precast concrete panels will often be made up of two wythes of concrete separated by a core of insulation. Expanded polystyrene (EPS) is the most frequently used insulation for reasons of cost and because it is very dimensionally stable.

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While some analytical methods of calculating fire endurance include the EPS insulation, its benefit is usually negligible and should not be considered. The presence of a thermoplastic material with a relatively low melting point should actually be considered a detriment rather than a benefit.

Reinforced concrete walls

Refer to the table below for estimating the fire endurance rating of reinforced concrete walls.

Actual Thickness in inches	Fire Rating
7 ½	4
6 ½	3
5 ½	2

Masonry walls

Masonry walls are often provided to separate manufacturing areas from storage areas. Such walls generally have sufficient fire resistance to function as acceptable separation. However, openings and penetrations may need protection. The fire endurance of masonry walls depends on the type of material and the thickness of the wall, if it is solid. For hollow units, the term equivalent thickness is used. This is the thickness of a solid wall that could be made from the same amount of material in the hollow wall if the material were recast into a solid mass. The table below shows a few typical construction materials and their associated fire rating.

Material	Thickness in Inches	Fire Rating
Brick (solid)	12 - all materials	10
	8 - sand and lime	7
	8 - clay and shale	5
	8 - concrete	6
	4 - clay and shale	1 ¼
	4 - concrete, sand & lime	1 ½
Concrete Masonry Unit	16	4
	12	3
	8	1 ¾

Wood-stud walls and partitions, ceiling and nonbearing

Construction	Material and Thickness (Each side or one side)	Fire Rating
Plasterless wall board on both sides on wood or metal studs	½ inch (actual) T&G sheathing boards	1/4
	¾ inch (actual) T&G sheathing boards	3/8
	¼ inch fir plywood	1/4
	½ inch fiberboard (fire retardant treated)	1/2
	3/8 inch type X gypsum board	1/2
	3/8 inch type X gypsum board (2 layers)	1
	½ inch type X gypsum board	3/4
	½ inch type X gypsum board (2 layers)	1 1/2
	5/8 inch type X gypsum board 2	1
	5/8 inch type X gypsum board (2 layers)	2

Type X gypsum board

Pure gypsum contains approximately 20 percent water within the calcium silicate crystal structure. When exposed to fire, it releases the water gradually, which helps a board to resist fire. In Standard Time-Temperature fire tests this typically takes 10 minutes to vaporize the water from a ½ inch thick board. As the water vapor is released, gypsum board loses some of its strength. To maintain the board's integrity and to extend its fire resistance, glass fiber reinforcement is

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in the manufacture of certain boards. In the USA these are referred to as type X gypsum wall boards. ASTM C 36 defines type X gypsum board as any gypsum board that provides not less than 1 hr fire resistance for boards 5/8 inch thick, or not less than ¾ hr fire resistance for boards ½ inch thick when applied on each side of wood studs 16 inches on center and tested in accordance with ASTM E 119.

Openings and penetrations

Openings in fire walls refer to breaks in the wall where objects, personnel, vehicles or materials pass through via an open system. Openings present the biggest threat to the integrity of fire walls. A fire wall is only as reliable as the protection of its openings; the fewer openings in a wall, the greater its reliability.

In general, openings are protected using fire doors, door packs, water spray, or fire dampers. Fire doors, door packs, and fire dampers should have an hourly fire rating suitable for the rating of the fire wall. Fire doors should be Approved and labeled.

Penetrations in fire walls consist of materials and/or equipment passing through the barrier, usually involving a closed system. Penetrations are generally smaller than openings and the space around the penetration needs to be sealed with an insulating (fire-stopping) material, and/or be completely cut off via a damper in order to prevent the passage of water, smoke, heat and fire. Penetrations include, but are not limited to, electrical conduit, ductwork, cable trays, sprinkler piping, mill-use water piping, and steam pipes. Like openings, the fewer the penetrations in a fire wall, the greater the reliability.

Wired glass

Minimum ¼-inch polished wired glass is routinely specified in fire doors and fire rated partitions. Wired glass is made up of annealed glass and a mild steel wire mesh. The mesh pattern may be square, rectangular, diamond shaped or hexagonal. The wire mesh is normally centered in the glass. Wired glass has a fire rating for integrity of approximately 45 minutes. It has no appreciable insulating value.

Conclusion

Fire walls are used to subdivide areas of high value, separate different occupancies or isolate hazardous processes and storages. Fire walls provide an important element of fire protection. They help to restrict the flow of heat and smoke from the area of fire origin. This containment helps limit sprinkler operation to prevent the depletion of the water supply, decrease smoke and water damage and provide manual fire fighting efforts a barrier from which to control the fire spread.

References

Factory Mutual Property Loss Prevention Data Sheets 1-19, 1-22, 1-44, 1-21, 1-23. Factory Mutual, 1151 Boston-Providence Turnpike, Norwood, MA. 02062

1999 NFPA National Fire Codes 13, 251, 80, 105, 221, National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

Fire Protection Handbook, Eighteenth Edition, Section 6, Chapter 7, National Fire Protection Association, Batterymarch Park, Quincy, MA 02269

Additional resources

There are many resources that can be of use in designing, estimating endurance of existing construction, or modifying existing construction. The following are some sources available:

Fire Resistance Design Manual, Gypsum Association, 1603 Orrington Avenue, Evanston, IL 60201

Fire-Resistant Construction in Modern Steel-Framed Buildings, (second printing, September 1959), The American Institute of Steel Construction, Inc., 1010 Park Avenue, New York, NY 10017

Fire Resistance Ratings, American Insurance Association, 85 John Street, New York, NY 10038

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Design for Fire Resistance of Precast Prestressed Concrete, Second Edition, Prestressed Concrete Institute, 175 W. Jackson Boulevard, Chicago, IL 60604

Guidelines for Determining Fire Resistance Ratings of Building Elements, Building Officials and Code Administrators International, Inc., Country Club Hills, IL 60478

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