

SE INSIGHTS

FOR MASONRY DESIGN

Masonry Fire Walls

A fire wall is a structural element designed to prevent the spread of fire between adjacent areas, particularly between different occupancies within a building or across lot lines. According to NCMA TEK 5-8B, one primary option for fire walls is the use of free-standing walls, which are engineered to remain intact even if the structures on either side collapse. This article will focus on the design considerations and methodologies for constructing such cantilevered masonry fire walls.

Firewall Design Options

Several design strategies can be employed when constructing cantilevered masonry fire walls, each tailored to meet specific structural and fire-resistance requirements. In this section, a few design options will be explored for cantilevered fire walls, considering a minimum lateral load of 10 psf, as required by the International Building Code (IBC), and using masonry with a specified compressive strength ($f'm$) of 2500 psi. Table 1 is based on the Cantilever Fire Wall Guide as specified by Masonry Standards Joint Committee (MSJC) 2011.

Option 1: Cantilevered Wall

A typical cantilevered wall detail is shown in Figure 1. The first example considers a 20-foot-tall single-story cantilevered wall. Per Table 1, this wall, fixed at the base and unsupported along its height, can be constructed using 6-inch CMU blocks reinforced with #5 bars spaced at 8 inches on center. Alternatively, an 8-inch CMU block can be used with #5 bars spaced at 16 inches on center, offering a similar level of structural performance.

For a more demanding application, such as a 30-foot-tall wall intended for either a tall single-story structure or a multi-story design, a 12-inch CMU block reinforced with #7 bars spaced at 24 inches on center would be appropriate. This increased wall thickness and bar size accommodate the greater loads and moments associated with taller walls.

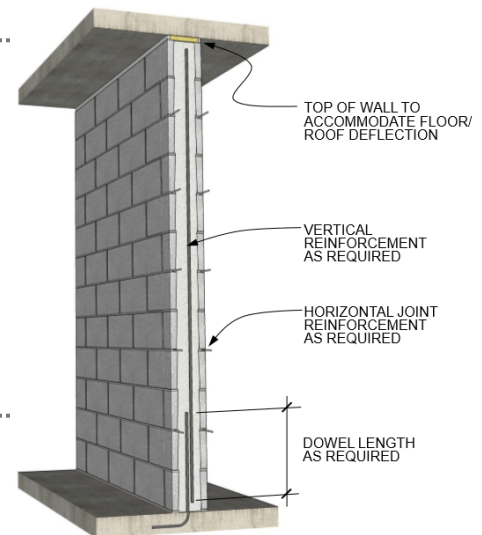


Figure 1: Cantilevered Wall Detail from IMI Masonry Detail Series, <http://imiweb.org/masonry-detailing-series/>

Table 1 - Cantilever Fire Wall Guide
 $f'm=2500\text{psi}$, 10psf loading, MSJC 2011

Wall Height	15 foot	20 foot	30 foot
6 inch thick	#5@16 PG	#5@8 SG	-
8 inch thick	#5@40 PG	#5@16 PG	-
12 inch thick	#5@72 PG	#6@48 PG	#7@24 SG
notes	PG=partial grout, SG=solid grout		

Option 2: Diaphragm Wall

Another viable option for fire wall construction is the diaphragm wall, which consists of two masonry wythes connected by cross walls or diaphragm walls, as shown in Figure 2. This configuration allows the two wythes to act compositely, significantly increasing the wall's height capacity.

For example, a diaphragm wall constructed with 8-inch CMU blocks, resulting in a nominal overall wall thickness of 2 feet, can be designed to cantilever up to 48 feet in height when reinforced with #5 bars spaced at 24 inches on center in each wythe. This design, following Allowable Stress Design (ASD) provisions, demonstrates the capability of diaphragm walls to support very tall structures. However, the trade-off is the increased wall thickness compared to a single-wythe wall, which may impact space utilization and construction costs.

Despite the increased thickness, diaphragm walls offer several advantages. Both faces of the wall remain flush, avoiding the need for pilasters, and the cavities within the wall can be used to house utilities, providing functional and aesthetic benefits.

Architectural Considerations for Fire Walls

Fire walls are subject to stringent regulations and criteria. They must extend continuously from exterior wall to exterior wall, and if the exterior walls are not fire-rated for a specified distance on each side of the fire wall, or if the adjacent structures are not protected by an automatic sprinkler system, the fire wall must extend beyond the exterior walls. Additionally, fire walls must extend from the foundation to the roof, and under certain conditions, they must project above the roofline to prevent fire spread over the top of the wall.

Penetrations through fire walls are also heavily regulated. Any openings must be protected by fire dampers, sleeves, or other approved methods to maintain the wall's fire-resistance rating. When control joints are necessary in concrete masonry fire walls, designers should consider using fire-rated caulking materials or employ structural design strategies that eliminate the need for control joints, as discussed in NCMA TEK 10-3.

Structural Performance and Practical Applications

In practice, the choice between a cantilevered wall and a diaphragm wall depends on various factors, including the required wall height, the fire-resistance rating, structural load demands, and architectural constraints. Cantilevered walls are often favored for their simplicity and straightforward construction, while diaphragm walls are chosen for applications requiring greater height or where integrated utility spaces are beneficial.

In conclusion, the design and construction of masonry fire walls require careful consideration of both structural and fire-resistance requirements. By selecting the appropriate wall type and detailing, designers can ensure that the fire wall not only fulfills its primary function of preventing fire spread but also contributes to the overall structural integrity of the building.

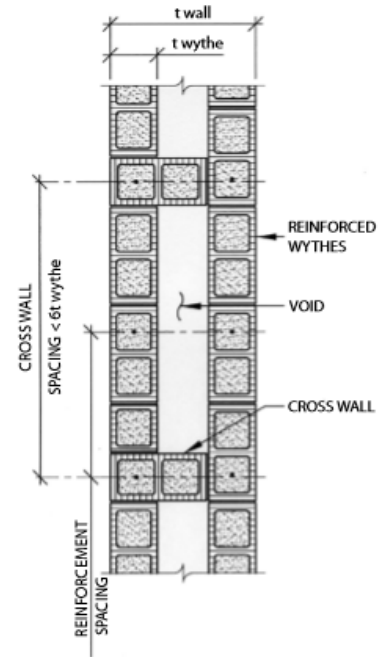


Figure 2: Illustration from STRUCTURE magazine article (May 2008), Designing Tall Masonry Walls