REINFORCED MASONRY FRLS

How to determine the Fire Rating (FRL) of reinforced concrete masonry walls

Midland Brick

CMAA

COMPONENTS OF A FIRE RATING LEVEL

A Fire Rating Level (FRL) is broken into three key components, with each considering an aspect of fire resistance:

1. **Structural Adequacy – the ability of a wall to remain standing during fire conditions**
2. **Integrity – the ability of a wall to prevent hot flames or gasses passing through**
3. **Insulation – the ability of a wall to resist the passage of heat through it**

STRUCTURAL ADEQUACY

Structural adequacy is dependent on slenderness, which is based on the height, length, thickness and side supports of a wall. According to Table 6.1 of AS 3700, reinforced masonry can achieve a 240-minute fire-resistance period (FRP) for structural adequacy if its slenderness is no more than 36.

For a wall supported on both vertical edges, slenderness (Srf) is taken as the lesser of:

$$S_{rf} = \frac{a_{vf}H}{t} \quad \text{OR} \quad \frac{0.7}{t}\sqrt{a_{vf}Ha_hL} \quad \text{OR} \quad \frac{a_hL}{t}$$

Back calculating these, the maximum heights and spans between vertical and horizontal reinforcement for 150 and 200 series walls can be seen below:

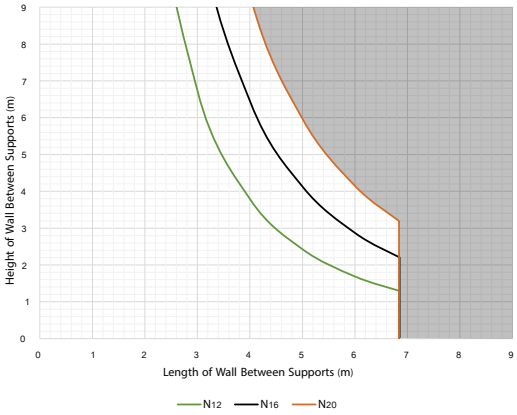
Series	Max Distance Between Reinforcement
140 mm	5040 mm
190 mm	6840 mm

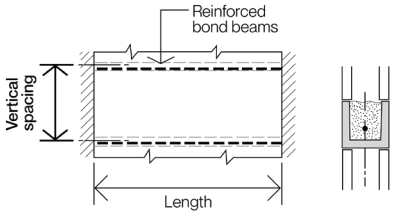
However, once the wall satisfies the slenderness requirements from AS 3700, the wall must also pass structural calculations for bending and shear as per Section 8 of the Standard. As a minimum, all masonry walls must be able to withstand a 0.5 kPa out-of-plane load for robustness.

Designers will need to check against their own design out-of-plane loads to ensure the wall is strong enough to achieve a given FRP for structural adequacy.

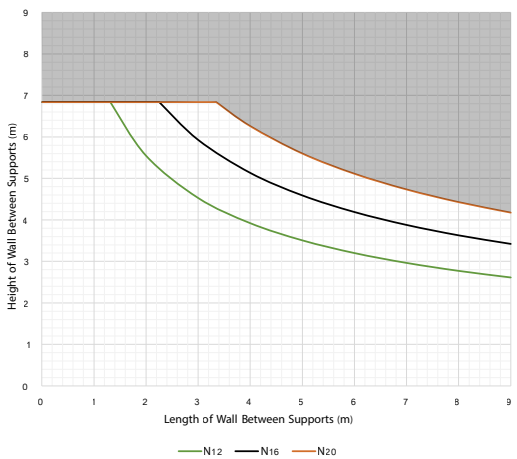
The charts below show allowable dimensions for walls, assuming a 0.5 kPa wind load. **Any shaded area in grey is not permissible.** Designers can select the correct reinforcement and spacing to ensure their wall is strong enough to withstand the 0.5 kPa load.

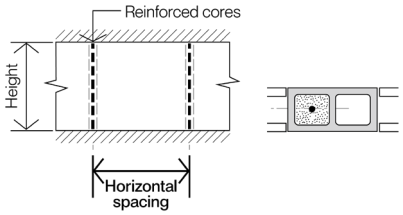
190 mm leaf, 30 mm shell bedding, horizontally reinforced





190 mm leaf, 30 mm shell bedding, vertically reinforced





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INSULATION

Insulation is dependant on the material thickness of the wall. For fully grouted masonry walls, the material thickness is taken as the thickness of the blocks. For a 140 mm thick wall, the material thickness is 140 mm and similarly, 190 mm for 190 mm units.

The density of the units also influences the insulation value. For lightweight units, the material thickness required to achieve a given FRP for insulation is reduced. For dense weight units, the material thickness required is increased. The table below is taken from AS 3700 for insulation FRPs of concrete masonry.

Density of concrete masonry unit	Material Thickness Required (mm)	
	Fire-Resistance Period for Insulation (min)	
	180	240
> 1800 kg/m^3	150	180
< 1800 kg/m^3	135	160

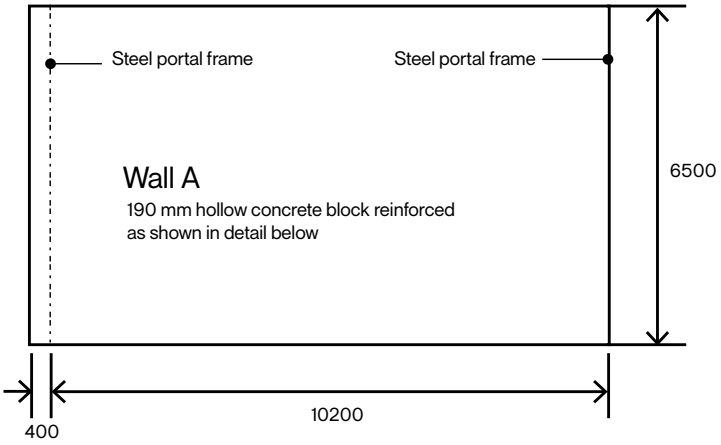
INTEGRITY

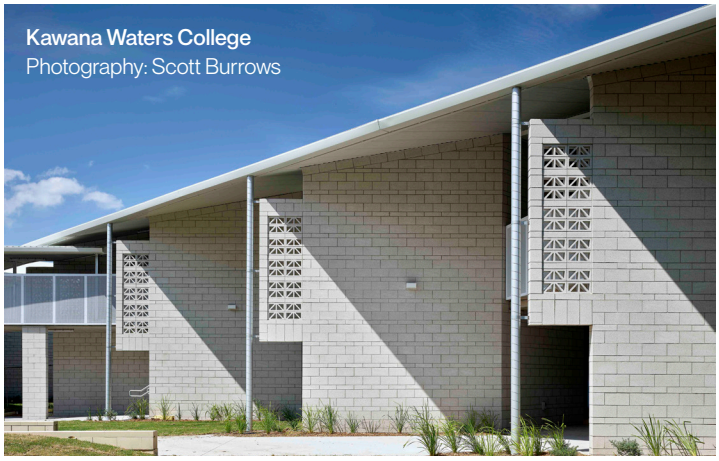
Integrity is based on the calculations for structural adequacy and insulation. It is taken as the lesser value of these. Therefore, if a reinforced masonry wall achieves a 240 minute FRP for structural adequacy, but is only thick enough to achieve a 180 minute insulation FRP, then integrity will be taken as 180 minutes. However, if the insulation value is also 240 minutes, then a 240/240/240 FRL can be achieved.

WORKED EXAMPLE

A full worked example with slenderness and structural calculations for a reinforced masonry wall is provided in MA 55 within the Fire Chapter. A simplified example is given below, assuming that the wall has sufficient capacity to withstand compression, flexure and shear loadings.

Check the FRL for Wall A, which is vertically reinforced and supported on four sides.




Kawana Waters College
Photography: Scott Burrows

STRUCTURAL ADEQUACY

Calculate slenderness ratio:

$a_{vf} = 0.75$ (top of wall is supported)

$$S_{rf} = \frac{a_{vf}H}{t} = \frac{0.75 \times 6500}{190}$$

$S_{rf} = 25.66$

$S_{rf} \leq 36 \therefore$ OKAY

Structural Adequacy FRP = 240 minutes

INSULATION

Calculate material thickness:

190 mm blocks = 190 mm material thickness

Using the table above for insulation, regardless of material density, the insulation FRP will be 240 minutes as material thickness is greater than 160 mm and 180 mm

Insulation FRP = 240 minutes

INTEGRITY

Calculate lesser of the other components:

Integrity will be the lesser of 240 or 240

Integrity FRP = 240 minutes

Therefore the wall will be 240 / 240 / 240

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