

# Exposed issues – reinforcing steel cover

When reinforcing steel is too close to the surface, it begins rusting and expanding, causing the surrounding concrete to break away.

**STEEL REINFORCING BARS** are used in concrete and concrete masonry to provide resistance to tensile loads and for concrete slabs and panels to help limit the risk of shrinkage cracking as the material cures.

The steel relies on being sufficiently deep (called cover) within the concrete to protect it from moisture and corrosion. Where it is too close to the surface or the concrete is poor quality, it will begin rusting. As steel rusts, it expands, and this can result in concrete spalling – where pieces of concrete are broken away by the expanding steel. As the concrete breaks away or cracks, more moisture can get in and the deterioration will accelerate. The corrosion will also reduce the tensile strength of the steel as the steel deteriorates.

## How much cover?

How much cover depends on:

- what the steel is embedded in – concrete or the grouted cells of concrete masonry
- concrete or grout strength
- what the surface of the concrete is exposed to – soil or air
- the corrosion or environmental zone
- the type of steel used – mild steel, galvanised, stainless steel
- intended life of the structure
- cement type.

Cover is measured from the outer edge of the reinforcing to the outside or exposed face or surface. Cover specified is for mild steel bars and makes no allowance for any properly applied and maintained coating system.

For footings and foundation walls, these are the minimum cover requirements in NZS 3604:2011 *Timber-framed buildings* and



NZS 4229:2013 *Concrete masonry buildings not requiring specific engineering design*:

- For concrete masonry:
  - 45 mm in exposure zone B
  - 50 mm in exposure zone C
  - 60 mm in exposure zone D.
- For concrete:
  - 75 mm for concrete placed directly on or against the ground (can be reduced to 50 mm where there is a DPM between the concrete and the ground (NZS 4229:2013))
  - 50 mm when placed against formwork – for NZS 3604:2011 buildings, the concrete strength must be appropriate for the exposure zone
  - 30 mm for the top of an exposed slab protected from the weather
  - 50 mm for any slab surface exposed to the weather.

Tables 1 and 2 outline the requirements from NZS 3101.1&2:2006 *Concrete structures standard*.

For concrete masonry structures built to NZS 4229:2013, the cover requirements from the external face of uncoated masonry are:

- for exposure zone B – 45 mm with 17.5 MPa grout
- for exposure zone C – 50 mm with 20 MPa grout
- for exposure zone D – 60 mm with 25 MPa grout.

For interior locations, the cover requirement for concrete masonry is 45 mm with 17.5 MPa grout.

Cover requirements for raw concrete masonry structures designed to NZS 4230:2004 *Design of reinforced concrete masonry structures* are given in Table 3.

**Table 1. Minimum concrete cover for a minimum 50-year durability of concrete structures.**  
(Table 3.6 NZS 3101.1&2:2006)

Exposure classification	Cement binder type	Specified compressive strength (MPa)						
		25	30	35	40	45	50	60-100
		Minimum required cover (mm)						
A1	GP, GB, HE	25	20	20	20	20	20	20
A2	GP, GB, HE	35	30	30	25	25	25	20
B1	GP, GB, HE	40	35	35	30	30	30	25
B2	GP, GB, HE	-	45	40	30	30	30	25
C	30% FA	-	-	-	60	60	60	55
C	65% GBS	-	-	-	-	50	50	50
C	8% MS	-	-	-	-	60	50	50

**Table 2. Minimum concrete cover for a minimum 100-year durability of concrete structures.**  
(Table 3.7 NZS 3101.1&2:2006)

Exposure classification (NZS 3101.1&2:2006)	Cement binder type	Specified compressive strength (MPa)						
		25	30	35	40	45	50	60-100
		Minimum required cover (mm)						
A1	GP, GB, HE	35	30	30	30	30	30	25
A2	GP, GB, HE	50	40	40	35	35	35	30
B1	GP, GB, HE	55	50	45	40	40	35	30
B2	GP, GB, HE	-	65	55	50	45	40	35
C	30% FA	-	-	-	-	70	60	60
C	65% GBS	-	-	-	-	60	50	50
C	8% MS	-	-	-	-	-	50	50

**Table 3. NZS 4230:2004 specific design masonry cover requirements**  
(adapted from NZS 4230:2004 Table 4.1)

Exposure categories		Durability requirements
Exposure zones	NZS 3101.1&2:2006 exposure classifications	Minimum cover to reinforcement (mm) <sup>1</sup>
Sea spray	B2 and retaining walls	60 (30)
1 and 4	B1	50 (20)
2 and 3	A2	45 (15)
Closed interior	A1	35 (5)
Geothermal hotspot	U	Special study

Note 1. The figure in brackets is the minimum dimension between the steel edge and the inside face of the masonry unit shell assuming a face shell thickness of 30 mm.

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