



# CONCRETE MASONRY

a guide to weathertight construction



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# ACKNOWLEDGEMENTS

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# FOREWORD

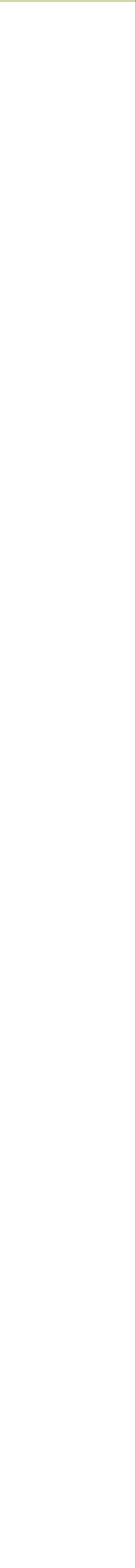
The Department of Building and Housing and Building Research have supported the New Zealand Concrete Masonry Association in producing this Code of Practice for weathertight construction of concrete masonry. It is encouraging to see industry groups creating guidance documents and codes of practice which complement departmental guidance and compliance documents.

There has been much consideration in recent times of weathertightness of construction in general. The issue is also important for concrete masonry buildings containing habitable spaces where the presence of moisture would also lead to the formation of mould and mildew.

This document will provide useful guidance for those considering solutions for compliance with Clause E2, External Moisture of the New Zealand Building Code. As part of its preparation, industry consultation with sectors associated with concrete masonry has resulted in this Code of Practice reflecting substantial experience in weathertight detailing of low-rise New Zealand concrete masonry buildings.



**John Kay**  
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### 1.1 Purpose and scope

This Code of Practice describes the requirements when specifying and detailing concrete masonry to ensure that completed habitable buildings will meet the performance specified in NZBC Clause E2 External Moisture. All concrete masonry is an Alternative Solution for compliance with E2.

Concrete masonry buildings, whether of specific or non-specific design, must be within the limits described in the scope below to be able to be designed and constructed in compliance with this document.

The information contained in this publication is appropriate for most low rise buildings in New Zealand, either as single skin concrete masonry constructions only or in combination with other materials. This publication does not include reinforced masonry construction with an additional masonry veneer.

The details and comments in this document are appropriate for Categories IV and V in NZS 4203 **General structural design and design loadings for buildings**. Category V is buildings of a secondary nature. Category IV is buildings not included in any other category, that is, buildings that are not:

- dedicated to the preservation of human life, or for which loss of function would have a severe impact on society
- generally containing crowds
- publicly owned buildings containing things of high value to the community.

AS/NZS 1170 is expected to be cited in place of NZS 4203 by the end of 2007.

The contents of this publication may be used where the above limitation is met, and where the building involved:

- is less than 10 m above ground level
- has floor plan areas limited only by seismic and structural control joints
- has wind zones up to Very High.

Individual designers must consider the appropriateness of their details for their particular applications where they differ from those in this document. Provided the principles in the drawings and text are followed, the details may be accepted as Alternative Solutions for weathertightness.

# PERFORMANCE REQUIREMENTS

2

2

## 2.1 Standards

The following Standards are pertinent to designing concrete masonry buildings:

- AS/NZS 1170 **Structural design actions**
- AS/NZS 4455:1997 **Masonry units and segmental pavers**
- NZS 4230:2004 **Design of reinforced masonry structures**
- NZS 4229:1999 **Concrete masonry buildings not requiring specific engineering design**
- NZS 4218:2004 **Energy efficiency – small building envelope**
- NZS 4214 (INT):2002 **Methods of determining the total thermal resistance of parts of building**
- NZS 4210:2001 **Masonry construction: materials and workmanship**
- NZS 4203:1992 **General structural design and design loadings for buildings**
- NZS 3604:1999 **Timber framed buildings**
- NZS 3124:1987 **Specification for concrete construction for minor works**
- NZS 3122:1995 **Specification for Portland and blended cements (general and special purpose)**
- NZS 3121:1986 **Specification for water and aggregate for concrete**
- NZS 3109:1997 **Concrete construction**
- NZS 3104:2003 **Specification for concrete production**
- NZS 3103:1991 **Specification for sands for mortars and plasters**
- AS/NZS 4671:2001 **Steel reinforcing materials**
- AS/NZS 2311:2000 **Guide to the painting of buildings.**

The figures in this Code of Practice also make reference to:

NZS 3610:1979 **Specification for profiles of mouldings and joinery.**

## 2.2 Concrete masonry and weathertightness

### 2.2.1 Overview

Minimal weathertightness concerns have been experienced with painted, single skin concrete masonry buildings.

Concrete masonry units are porous. This permeability varies depending on what the units are made of (e.g. lightweight pumice aggregate is especially porous).

The mortar joints between concrete masonry units may also create a potential weathertightness issue. As new mortar dries and shrinks, cracks may develop between it and the masonry units. Correct tooling of the mortar, which re-compacts it after the units are laid, helps reduce the risk of cracking. A coating system, correctly selected, applied and maintained, is the only reliable means of ensuring weathertightness.

Care needs to be taken when designing details for weathertightness in concrete masonry as it does not fall neatly into the direct-fix category nor does it have a cavity. Cavity systems rely on drainage and

venting to ensure moisture does not penetrate into the interior. Direct-fix systems would normally consist of an impermeable cladding (behind which flashings may be placed to facilitate the shedding of water), unlike concrete masonry.

### 2.2.2 Weathertightness principles

Direction when designing building cladding systems is offered by the four 'D's' of Weathertightness. These are:

1. **Deflection** – a primary method for preventing water entry by diverting water from critical junctions
2. **Drainage** – ensuring water is removed from the wall construction
3. **Drying** – the ability to dry-out moisture within the wall
4. **Durability** – sufficient resistance to deterioration.

Concrete masonry is inherently durable – i.e. its structural integrity is not compromised if subjected to wetting.

But to ensure the health of the occupants, moisture needs to be excluded from the interior of buildings. Reliance is therefore placed on preventing the ingress of moisture by means of a waterproof coating.

This means the primary weathertightness principle employed in concrete masonry buildings is surface deflection.

#### Concrete masonry walls

Deflection of water can be achieved by:

1. Building elements that shelter the wall or divert water away from critical junctions – eaves (Figure 1), metal drip angles (Figure 2), built-up plaster drip edges and a 10 mm overhang of the concrete masonry to the slab.
2. Coating systems specifically designed, formulated and applied to seal the surface of the masonry, prevent water absorption into the masonry surfaces and allow it to drain/dry. **Refer 3.11 Weatherproof coating systems.**

#### Concrete masonry penetrations

Penetrations through walls such as windows and doors, may employ all four 'D's' in resisting weather:

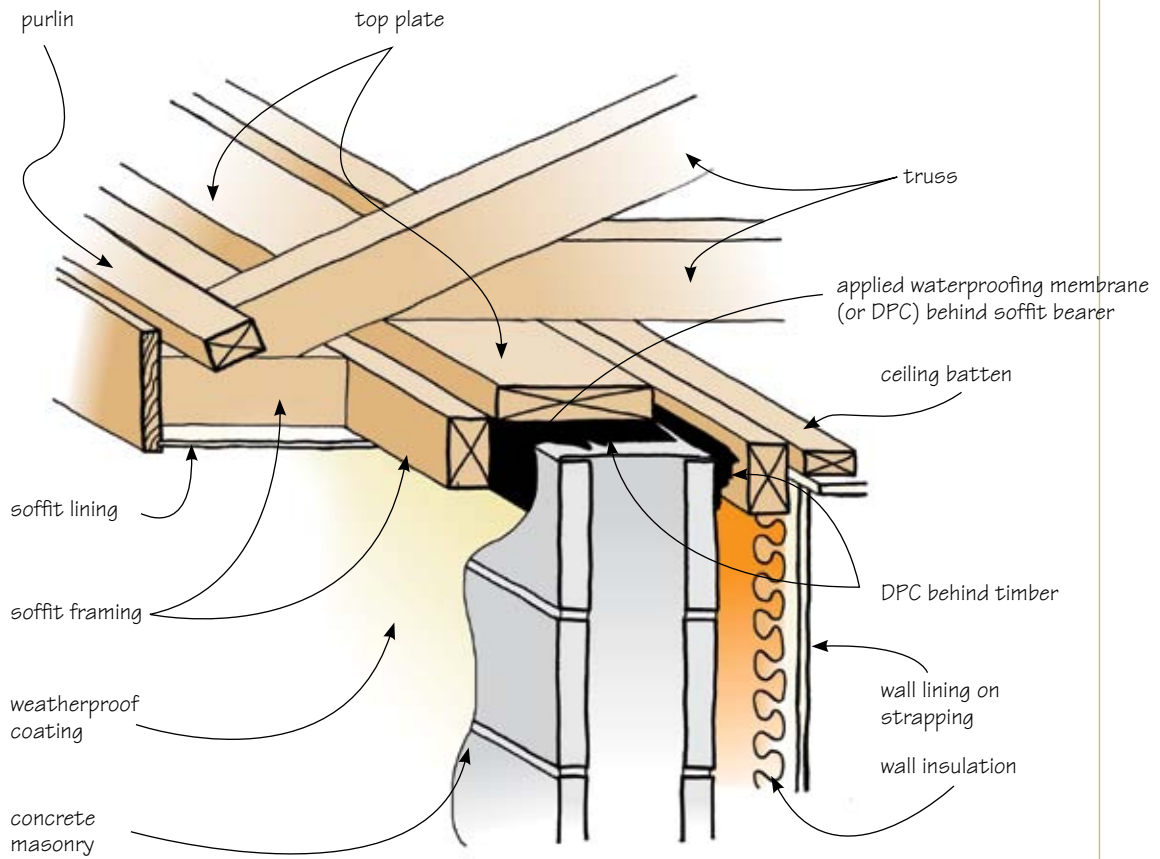
1. 'Deflection' as discussed above, particularly; overhangs and drip moulds, facings and general overlaps
2. Any water that gets in is then 'Drained' back out, generally through an unsealed joint along the bottom edge
3. This unsealed bottom edge also allows some air percolation to aid 'Drying' and helps balance air pressures around the trim cavity, minimising water entry
4. Air seals installed around the inside edges of openings restrict the passage of air through joints, and prevent water being carried through to the interior.

### 2.2.3 Weathertightness factors

Weathertightness can also be assisted by:

- having eaves (see Figure 1)
- correct detailing and construction of openings (Figure 7)
- cap flashing parapets and balconies (see Figures 4 and 5)
- correctly locating and constructing control joints (Figure 8 and 9)
- having sufficient mortar in the joints
- re-compacting mortar after initial hardening by tooling
- consolidating grout using an immersion vibrator.

Figure 1. Typical eaves



Cross-section of typical eaves

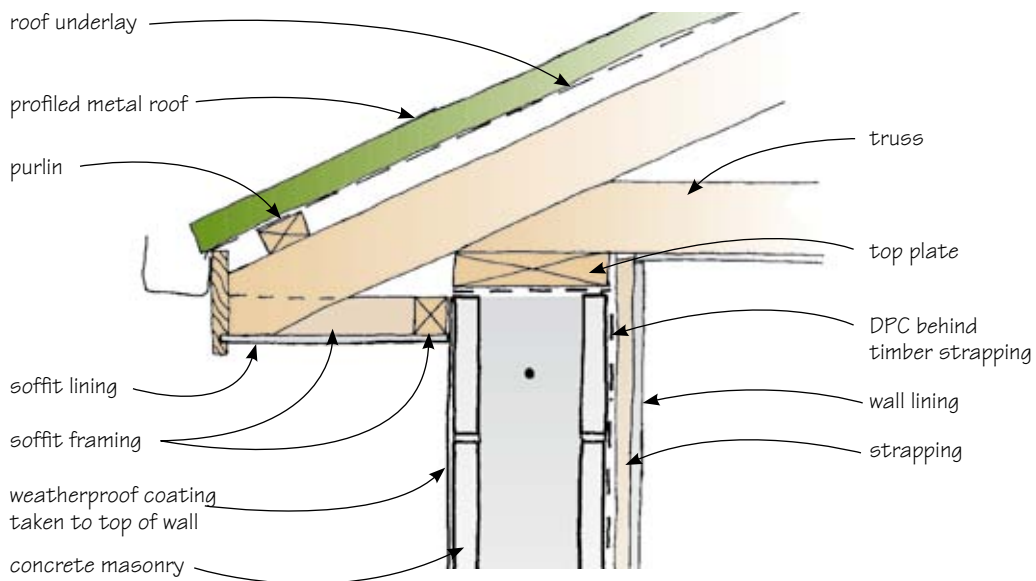
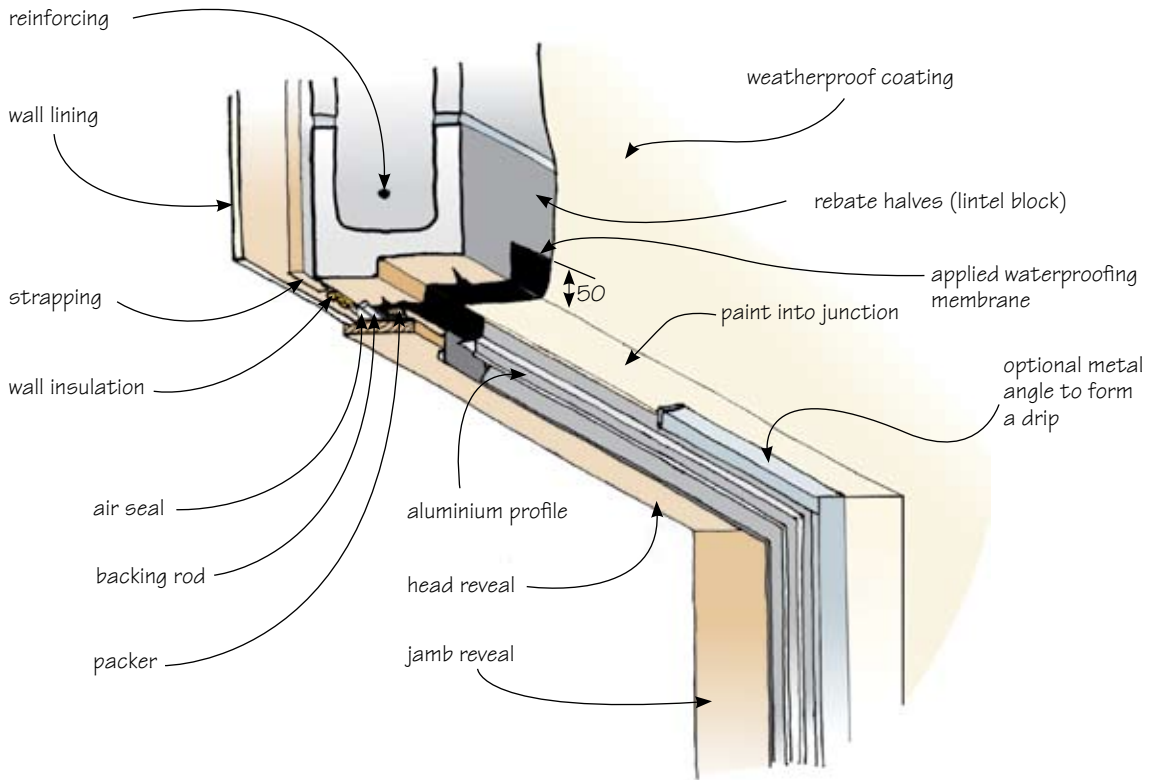
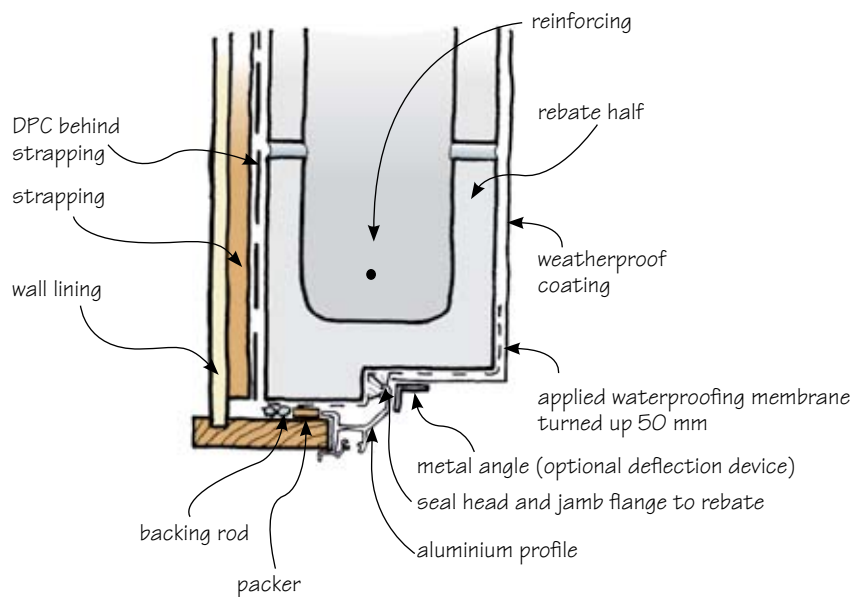


Figure 2. Window head – paint

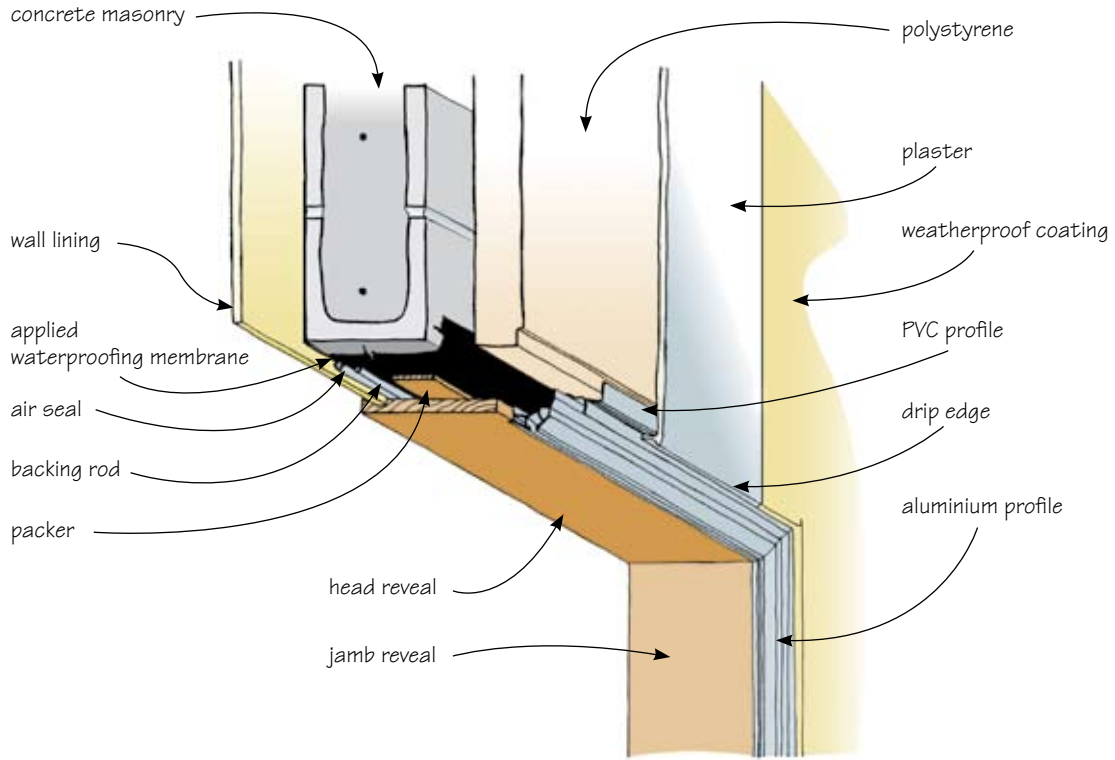


Cross-section of head of window

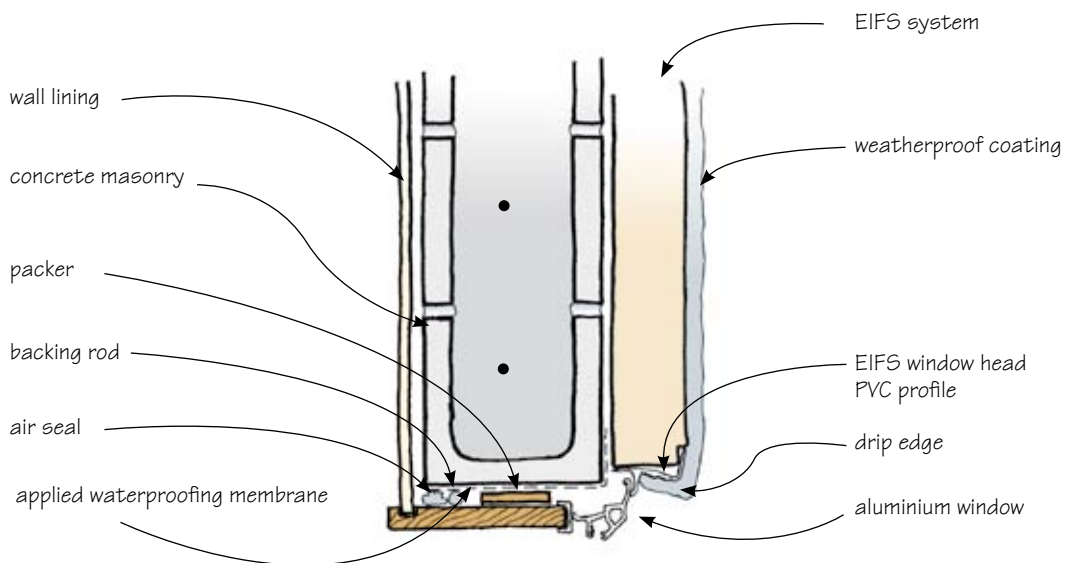


Note: Refer Figure 6 for sill detail

**Figure 3. Window head – EIFS**



**Cross-section of window head – EIFS**



Note: Refer Figure 19 for jamb detail, Figure 20 for sill detail

Figure 4. Balustrade/wall junction

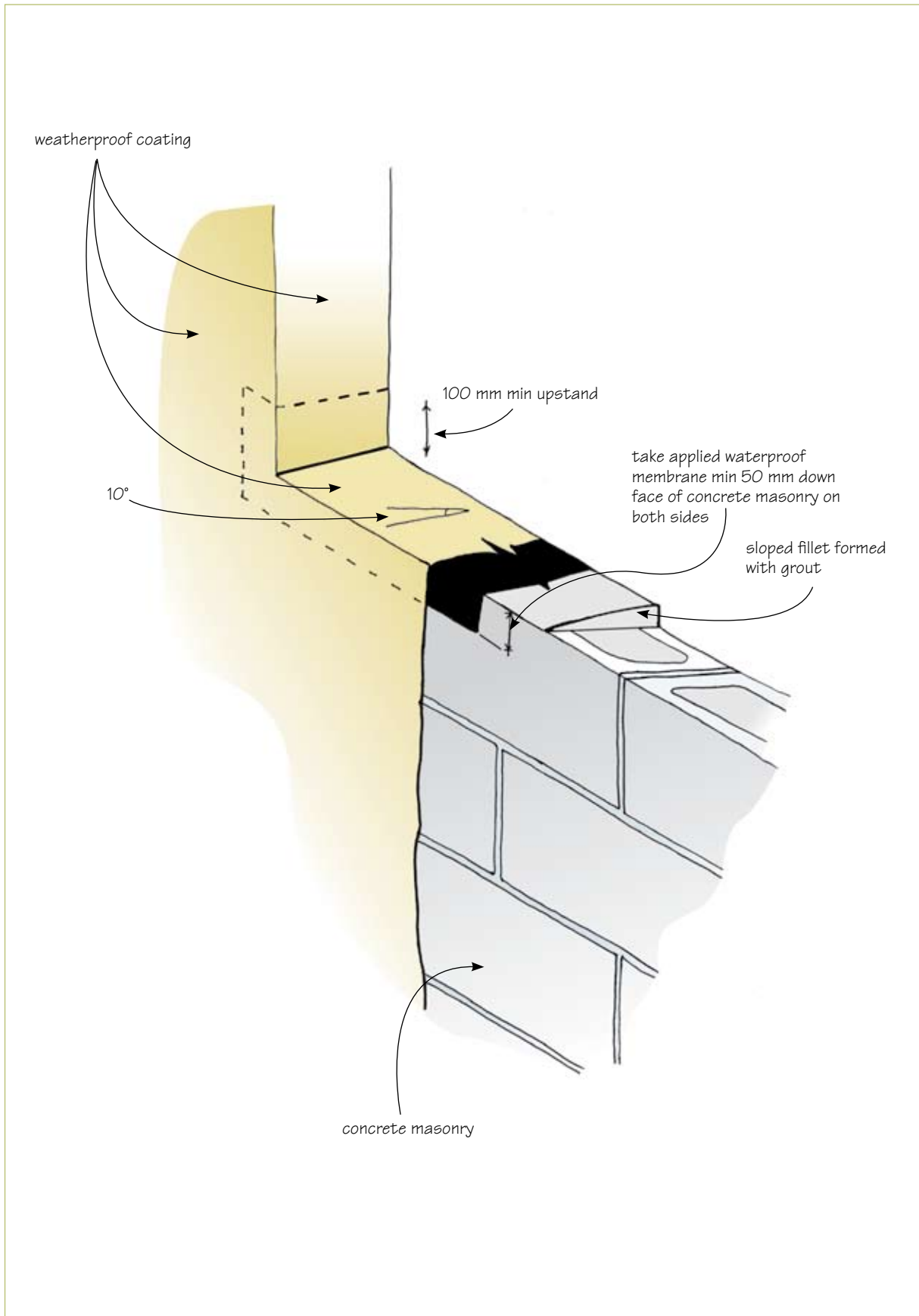


Figure 5. Parapet

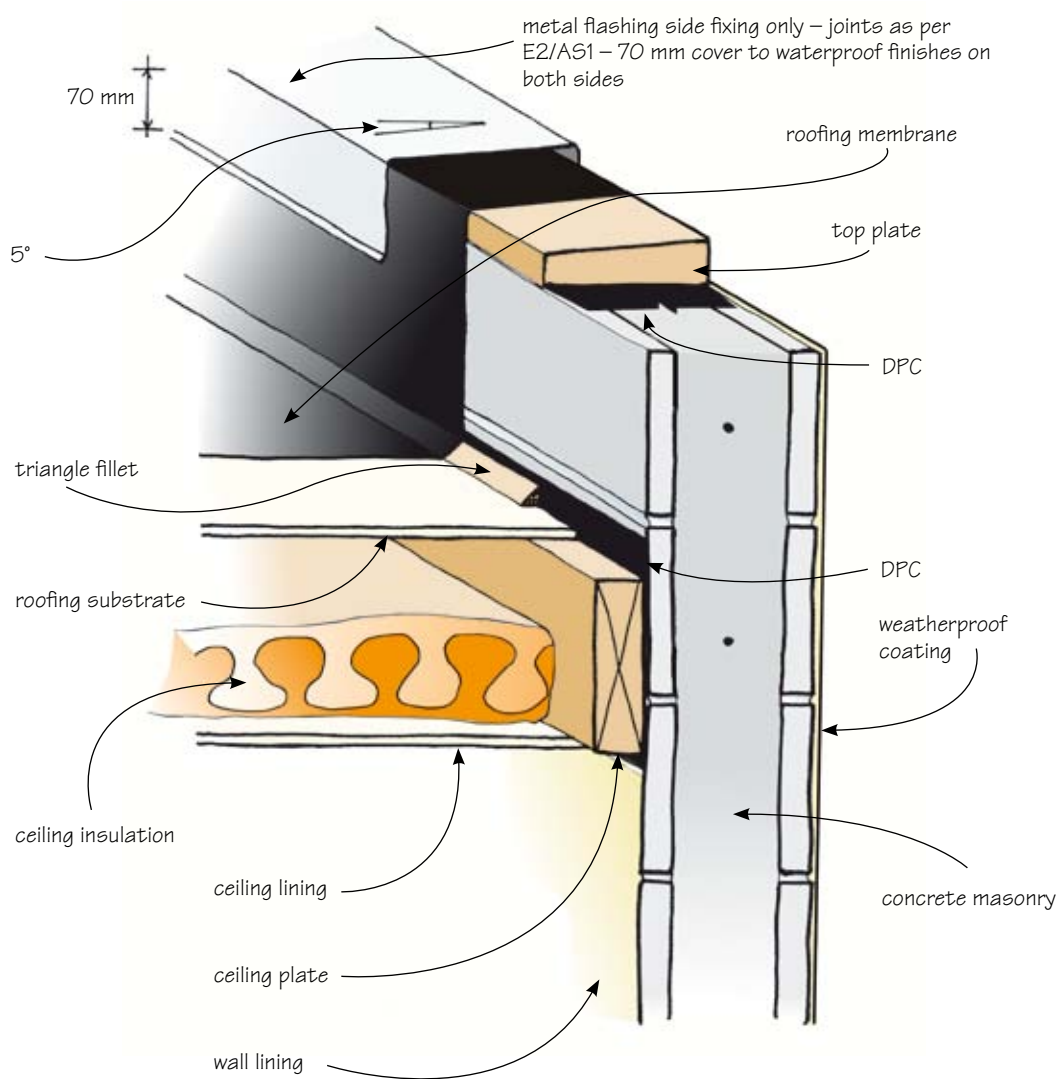
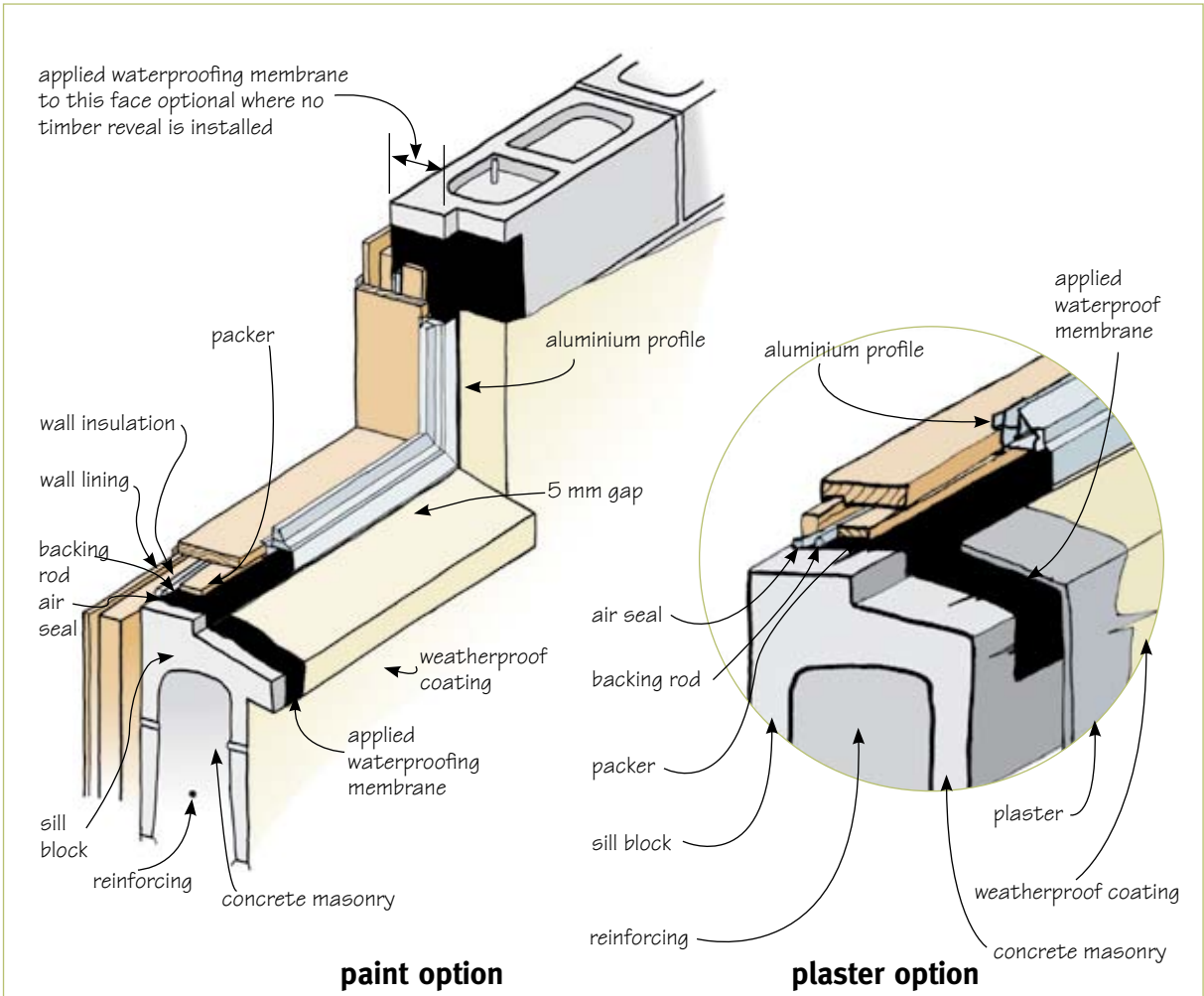
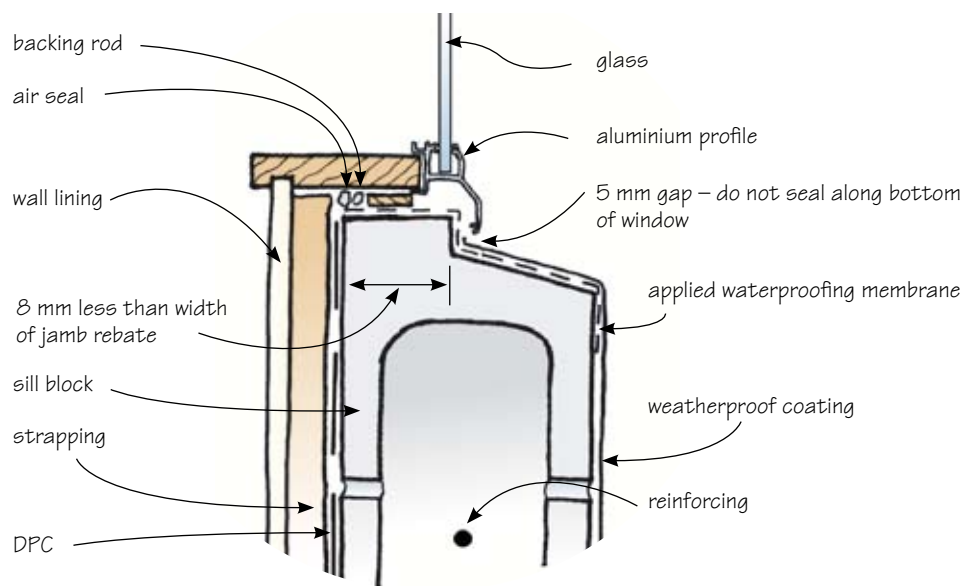


Figure 6. Window sill – plaster or paint



Cross-section of window sill – paint (without nib)



Note: Refer Figure 2 for head detail

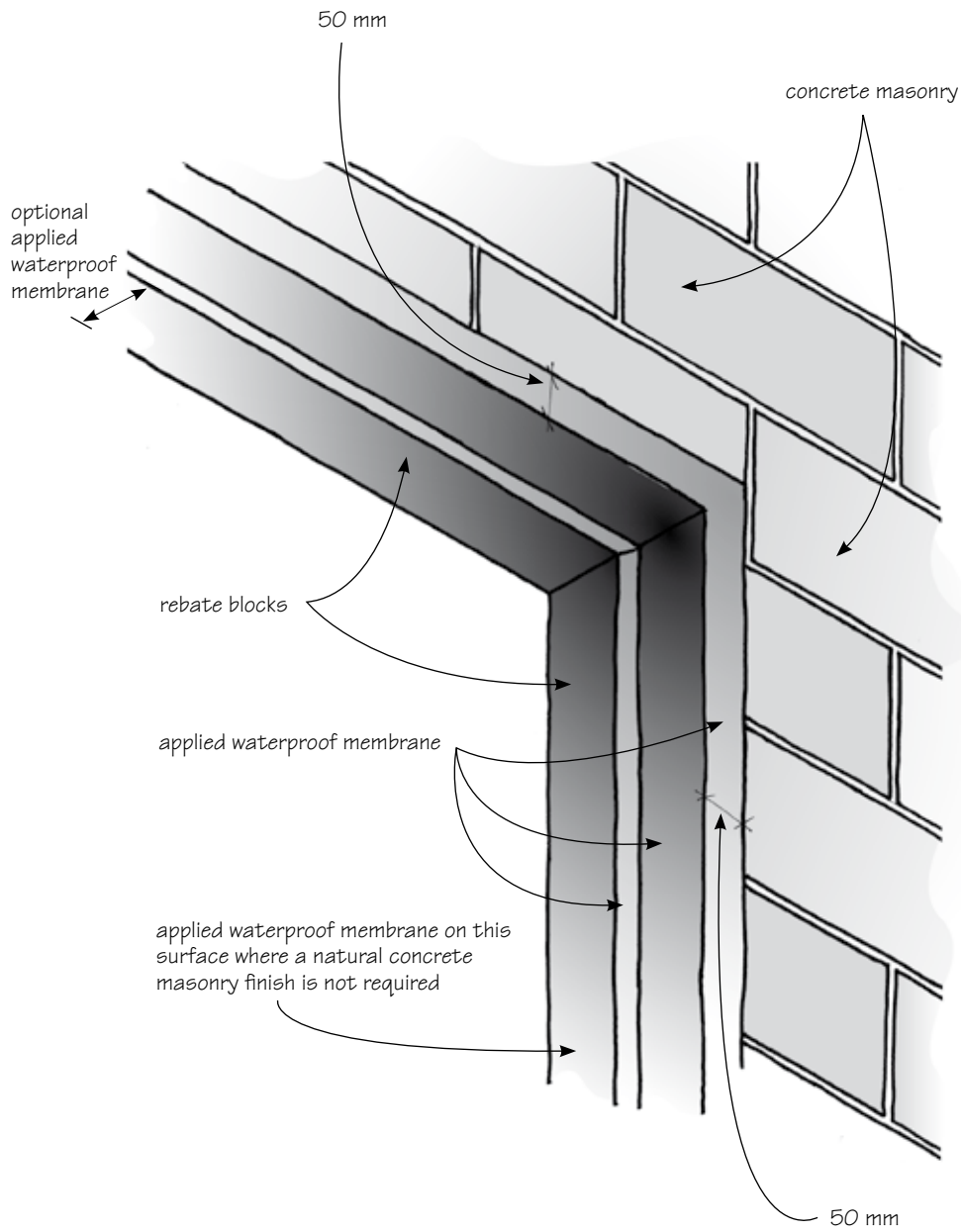
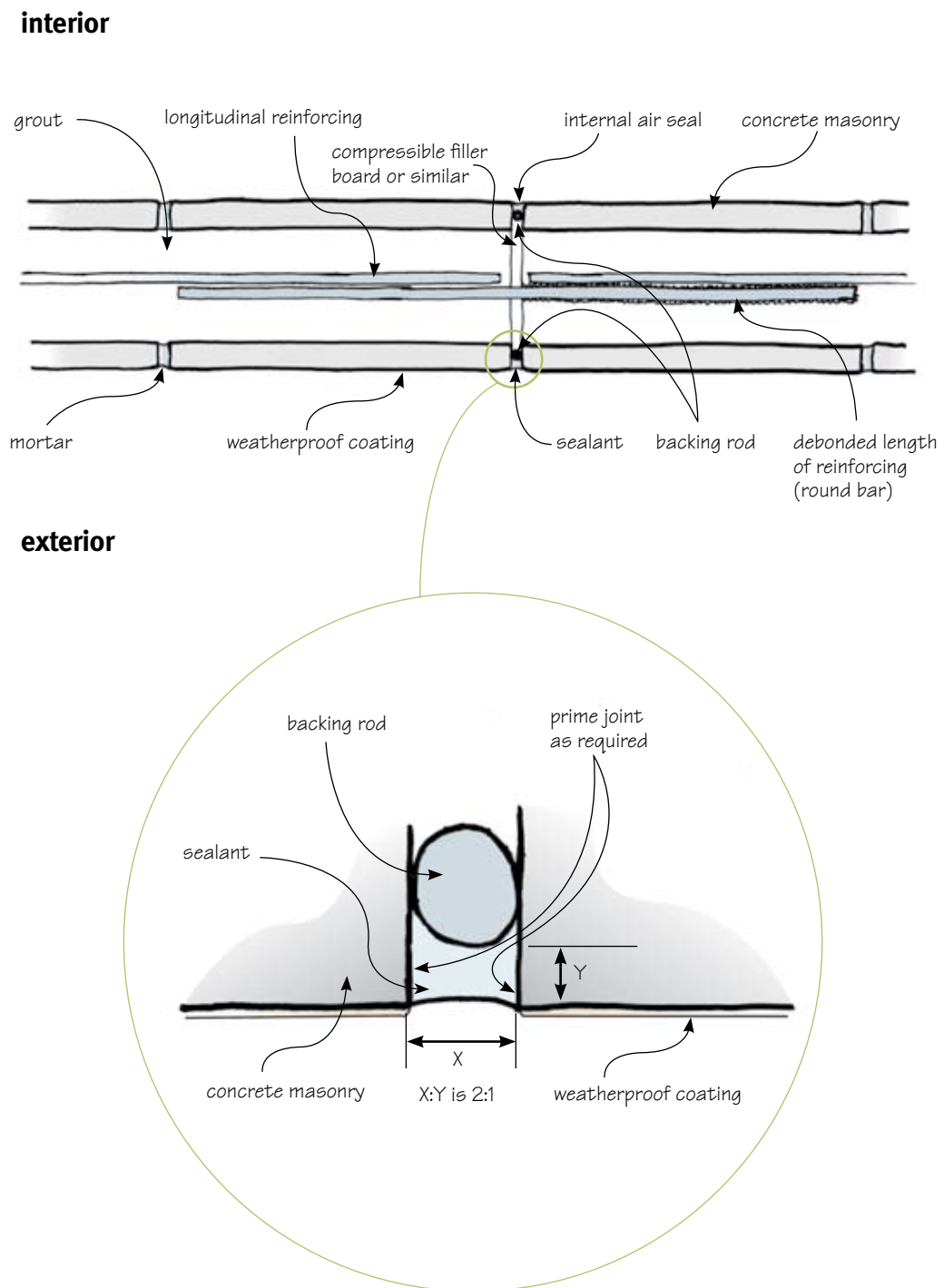
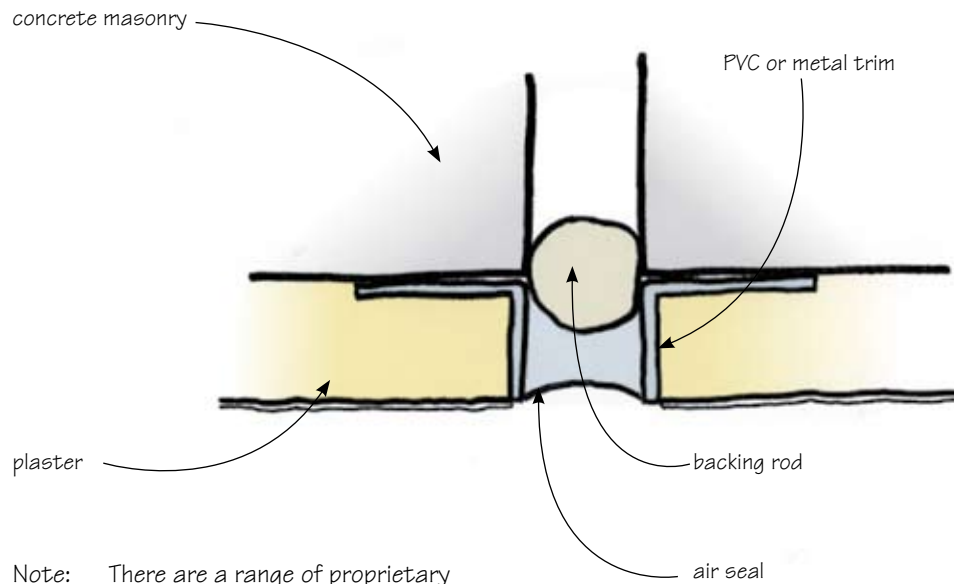
**Figure 7. Waterproofing joinery openings**

Figure 8. Control joints

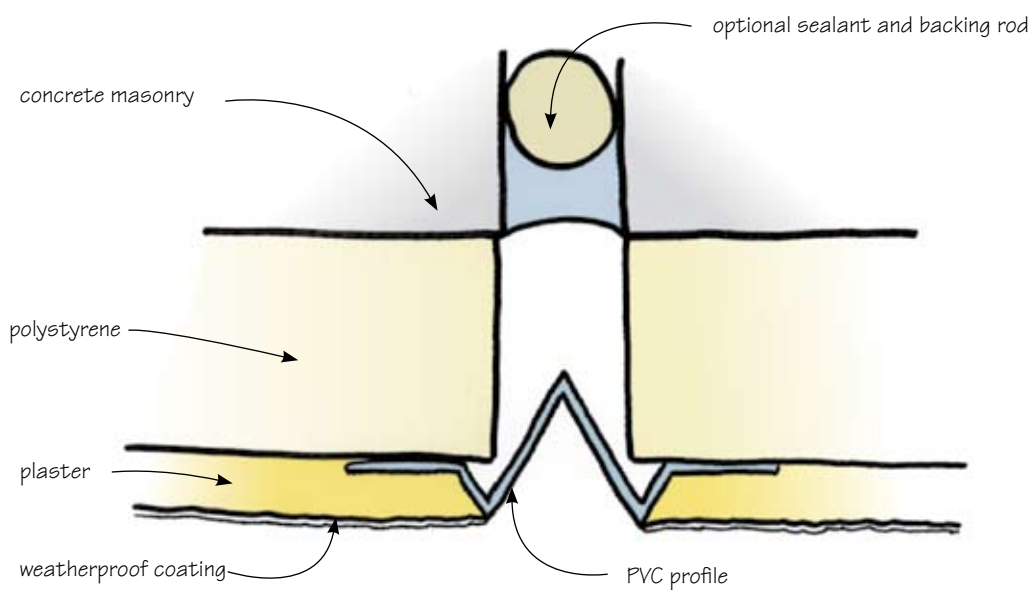


**Figure 9. Control joints – EIFS and plaster**

**Control joint – plaster**



**Control joint – EIFS**



# 3 CONSTRUCTION

## 3.1 Inspections

Inspections will need to be undertaken by building consent authorities (BCAs) to verify that the concrete masonry walls are built in accordance with the consented documents. Parts of the structure that are specific design may require inspection by a chartered professional engineer. Provide sufficient notice for inspections by BCAs and chartered professional engineers, especially for work that will be closed in.

Specific weathertightness checks should include:

- waterproofing of window openings and doorways before installation of windows and doors to ensure the rebates are sealed
- windows and doors after installation and before lining
- flashings
- coating thickness/quality and continuity.

The mason should record, as per NZS 4210:

- proportions of materials used for mortar
- supplier of grout and control test certificates
- mix proportions for site-mixed grout
- daily spread of grout test values
- expansive agent type and dosage, if used.

## 3.2 Ground clearances

The clearance heights from ground to floor level for concrete masonry from NZS 4229 are:

- 150 mm from unprotected ground
- 100 mm from paving
- 40 mm adjacent to garage doors.

Cleared ground must slope away from the building at a rate of not less than 1:25 for a distance of at least 1 m (Figures 10 and 11).

## 3.3 Concrete masonry units

Concrete masonry materials shall comply with NZS 4210. Concrete for masonry units must comply with NZS 3109 and shall have a minimum compressive strength of 12.5 MPa by 28 days.

Masonry units are readily available in the 15 series, 20 series and 25 series.

## 3.4 Foundations

It is important that the building is well founded, as this prevents subsidence leading to differential settlement within the structure. Subsidence will result in cracks through which moisture may gain entry.

Refer to NZS 4229 for design of foundations.

### 3.4.1 Base detailing

NZS 4229 permits the laying of the concrete block wall directly on the concrete slab.

An alternative detail which provides additional protection against water entry is to form a recess in the floor and start the concrete masonry wall 100 mm before floor level.

To get back to masonry modular height it is recommended to use a half-height masonry unit in the rebate.

## 3.5 Reinforcement

NZS 4229 covers both foundation and wall reinforcing in detail.

The table in Appendix 2E (NZS 4210) states cover requirements for reinforcement, depending on the geographical location of the concrete masonry building. Correct cover **is required** to protect reinforcing steel from corrosion and subsequent spalling of the concrete.

## 3.6 Mortar joints

Mortar quality and installation is integral to the weathertightness performance of the concrete masonry.

### 3.6.1 Mortar function

Mortar joints:

- bond adjacent units together – this is vital where units are to be left unfilled
- take up construction or manufacturing tolerances from slight variations in block sizes
- contribute significantly to the appearance of a block wall
- are typically 10 mm thick with a tolerance of +/- 3 mm (NZS 4210)
- can be up to 20 mm thick as a leveling course for the first course
- should be a consistent thickness throughout the wall
- need to provide a minimum 28 day compressive strength of 12.5 MPa.

### 3.6.2 Mortar mix

Weathertightness is optimised when mortar is correctly made – refer to NZS 4210. Mortar can be supplied as bagged dry mix or mixed from bulk materials on site. In particular, site-mixed mortar should be the right proportions of sand, cement, water and lime or admixtures, measured with buckets or gauge boxes, not by shovel. The correct proportions reduce the likelihood of cracking.

All mortar should be:

- mixed correctly – mechanically for at least five minutes
- used at the correct consistency – when mortar does not fall off an upside-down trowel it is not too dry or too wet
- used within 1.5 hours – admixtures to retard drying may extend this time
- tooled

- re-tooled after the concrete masonry units are laid and the initial set has occurred to fully compact mortar into joints.

### 3.6.3 Tooling of mortar joints

Tool the joint to improve the performance of the mortar. Tooling is required to reconsolidate the mortar joint after the initial water loss once the mortar is thumbnail hard.

### 3.6.4 Mortar joint profiles

Preferred mortar joint profiles for maximising watertightness for exposed joints (Figure 14) are:

- concave
- vee

Flush joints (see Figure 14) may be used where there is to be cement plaster or tanking applied to the concrete masonry. For EIFS claddings, tool joints before polystyrene installation. Use of a flush joint profile does not negate the need to tool and re-tool the joint surface.

## 3.7 Grouting

Correct grouting will enhance a wall's ability to be weathertight. Grout used for the filling of cells must comply with NZS 4210 and NZS 4229.

A specific block-fill mix must be used, not a standard concrete mix. Block-fill is far more fluid and will flow into all the parts of the wall. It is necessary that the grouting is carried out by an experienced tradesperson.

The requirements for grout are a:

- spread value of 450 – 530 mm
- minimum strength of 17.5 MPa at 28 days
- mixing ratio obtained from NZS 4210 for site mixing, ready-mix to NZS 3104.

For buildings located in the sea-spray zone (typically within 500 m of a beach or as determined by the BCA) the minimum compressive strength should be 25 MPa.

NZS 4210 sets out different methods for grout filling:

- high lift grouting with an expansive admixture – in maximum 3.6 m lifts
- 1.2 m lifts to a maximum of 3.6 m without an expansive admixture
- high lift grouting to 2.4 m high lifts
- low lift grouting – in 1.2 m lifts.

Before commencing grouting, check grout spaces have been cleaned out and that the mortar joints have attained sufficient strength for the lift height to resist blow-outs.

Grout must be thoroughly compacted by rodding or vibration to completely fill all cells and cavities containing reinforcement and other cells to be solid filled. Vibration is to be preferred as it gives denser grout with better water resistance. Secondary vibration (vibration applied after initial compaction) is required to achieve sufficient consolidation.

## 3.8 Shrinkage control

Shrinkage control joints are required to prevent cracking occurring randomly. The design and installation of these joints must provide continued weathertightness.

Vertical shrinkage control joints in concrete masonry must be spaced at a maximum of 6 m centres as per NZS 4229. Location of these joints is also influenced by major changes in wall height, changes in wall thickness, wall intersections and opening locations.

Control joints (see Figures 8 and 9) on external walls must:

- comprise a continuous 10 mm wide raked back vertical joint (no mortar)
- include a sealant bond breaker at the back of the joint
- be reflected through applied finishes such as solid and EIFS plaster to control cracking.

Vertical control joints should be plumb and of the same width as the mortar joints so they are less obvious. They are made by having a break in the existing horizontal reinforcing, beside which a length of debonded reinforcing is placed (see Figures 8 and 9).

## 3.9 Sealants

Correct sealant selection and application is required to assist weathertightness in a concrete masonry building.

Sealants must:

- have a 2:1 width-to-depth ratio with back-up PEF rod
- withstand heat, cold, ultraviolet radiation, water, and thermal and moisture movement
- completely fill the joint to the required depth and profile and have no entrapped air within the sealant
- be in contact with the sides of the joint for the full sealant depth
- have joints primed where required by the sealant manufacturer.

Typical sealant life is between 10 to 20 years, necessitating sealant joints to have the ability to be inspected, maintained and replaced during the life of a building.

Painting over sealants is not recommended as:

- sealant may not be compatible with the paint
- the cured paint film will not have the movement capacity of the sealant
- it may reduce the life of the sealant.

### 3.9.1 Joint preparation

Joints must be free of dust or laitance, loose or crumbly material, and curing compounds. Damaged edges must be repaired to obtain a regular joint profile.

### 3.9.2 Priming and application

Before **priming**, mask surfaces on both sides of the joint to prevent staining by the primer and sealant. Make sure that the primer is one recommended for porous surfaces and that the primer is formulated to bond to the concrete substrate.

During **application** ensure that:

- sealant is applied within the open time specified
- the cartridge gun is pushed in the direction sealant is being applied
- sealant is applied over backing rod
- the sealant wets sides of joints and any trapped air is brought to the surface
- the joints are tooled to obtain a smooth finish
- temporary protection is provided, if necessary, to keep panels and joints dry and at the required temperature until the sealant is cured.

### 3.9.3 Modified silicone sealants

Modified silicone sealants can be used in control joints and are one-part sealants with a neutral cure and:

- have excellent weathering resistance with a life expectancy of up to 20 years
- are non-yellowing, non-slumping and can be painted
- adhere well to non-porous substrates.

### 3.9.4 Polyurethane and silicone sealants

Polyurethane and silicone sealants:

- are less likely to harden with age
- have moderate abrasion resistance.

However, these sealants:

- need to have dry substrates during application
- are prone to yellowing in ultraviolet.

Sealants require up to three weeks to cure depending on sealant, joint size and ambient conditions. The depth of the joint is limited to 15 mm and the width to 30 mm.

Silicone sealants are one-part sealants and have a range of characteristics depending on formulation. These sealants:

- have a low tear resistance
- require good surface preparation and priming for optimum performance
- may cause staining which will discolour natural stone
- typically cannot be painted.

Acid-cure silicones are not recommended for use with alkaline substrates – such as concrete masonry. Neutral-cure silicones though have sufficient tensile strength and can be used as a general purpose construction sealant.

## 3.10 Flashings

Flashings must be provided at parapets, gutters, roof intersections and larger projections (Figure 15 and see Figure 5). Flashings that are chased into the concrete masonry must not weaken the structural integrity of the wall, but be designed to exclude water.

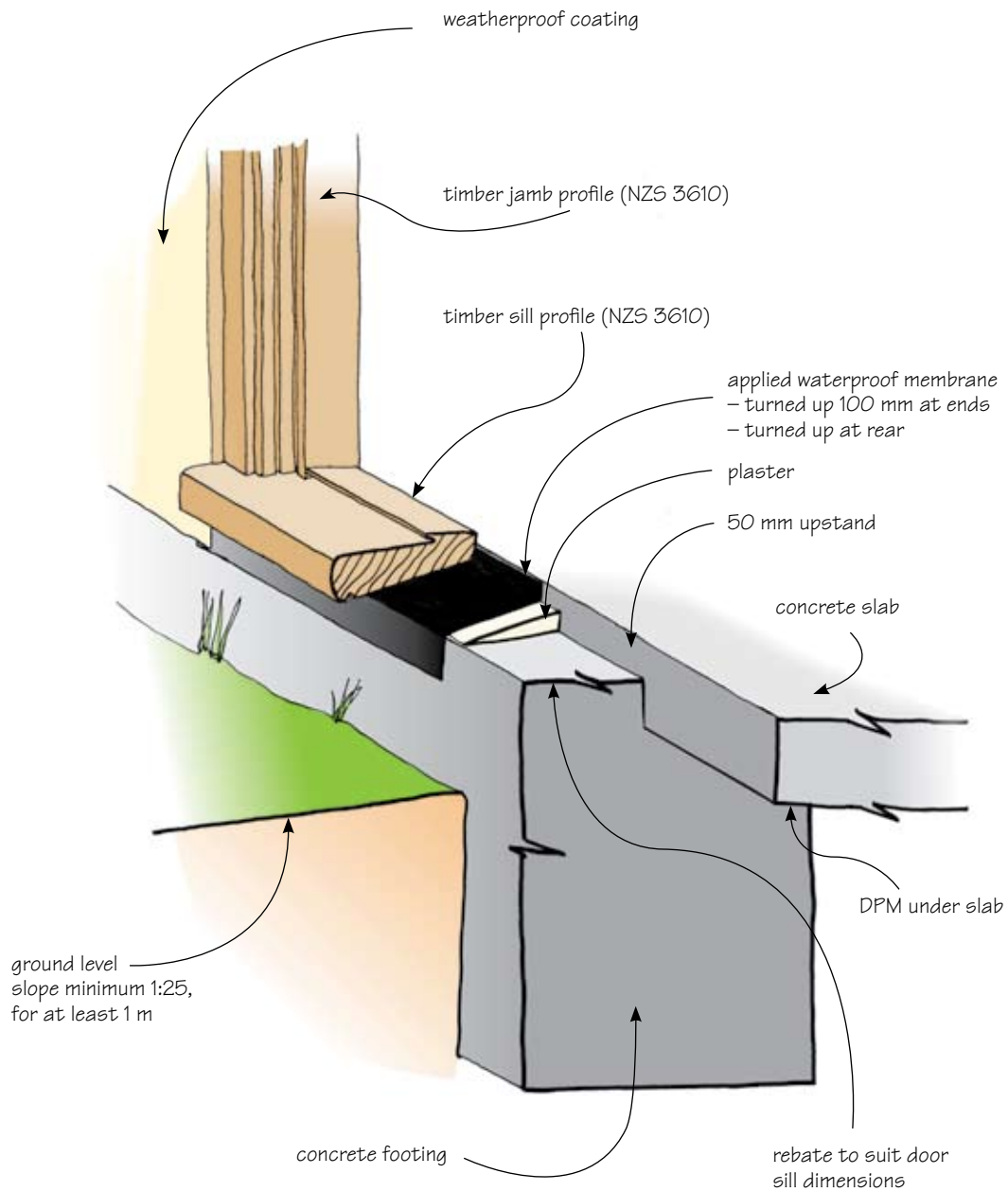
This is achieved by chases for flashings not deeper than 15 mm and 15 mm wide. Flashing into the small chase is difficult (see Figure 15).

A sealant is applied into the chase and then the flashing is inserted, and the sealant tooled.

Any flashing used must:

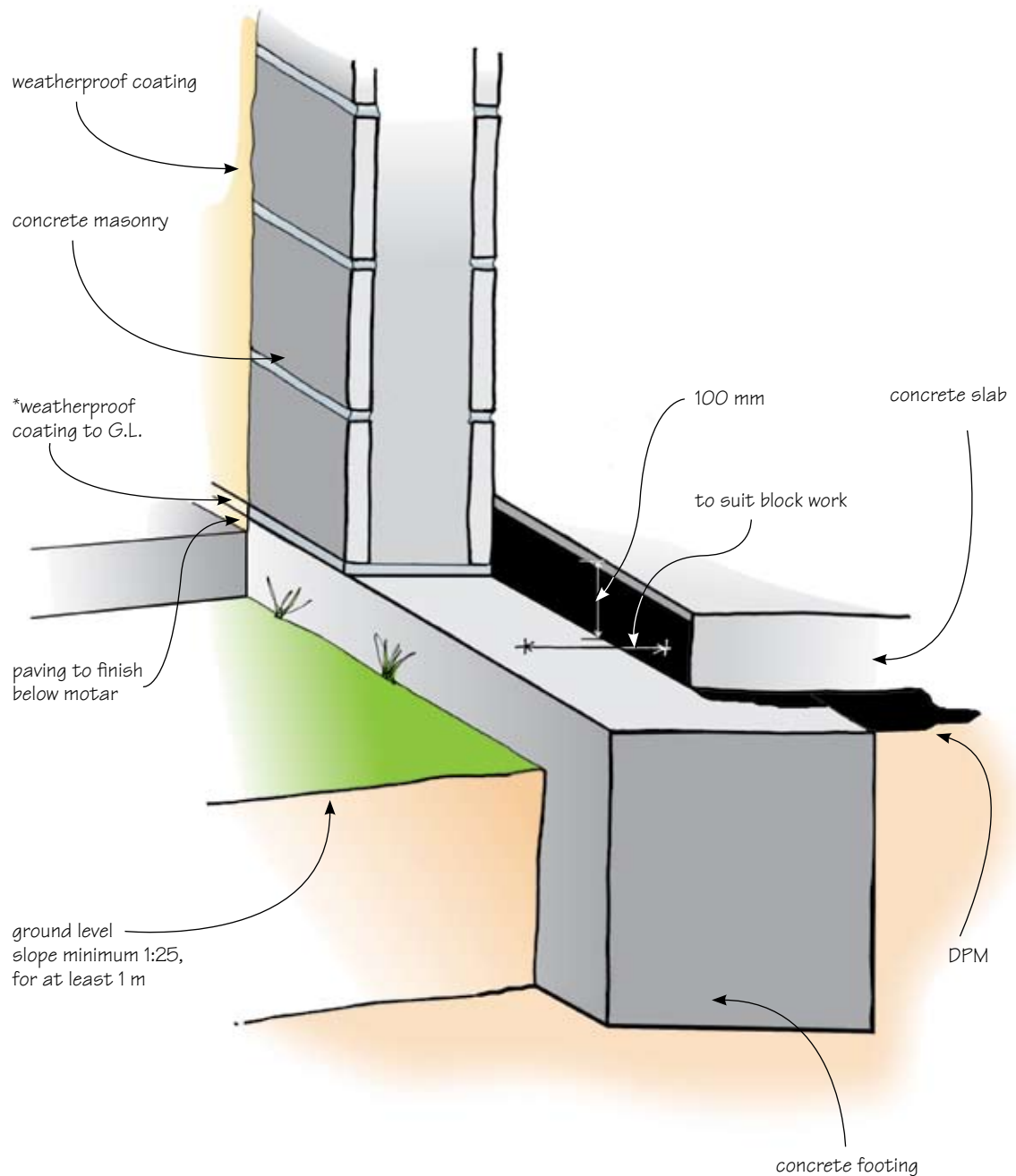
- be resistant to alkali in masonry units or mortar
- be compatible with the coating on the wall
- have their lower edges bent outwards at least 10 mm so water drips clear
- have an upstand with sufficient height to prevent capillary action and wind influence (E2/AS1 requires a minimum upstand of typically 110 mm)
- be suitable for the area's corrosion zone.

Figure 10. Door sill – plaster or paint



Note: Refer Figure 17 for head detail and Figure 18 for EIFS jamb detail

Figure 11. Slab foundation



**\* Note:** Where no slab rebate weatherproof coating to be taken to 100 mm below slab level

Reinforcing omitted for clarity

Figure 12. Slab foundation thickened edge

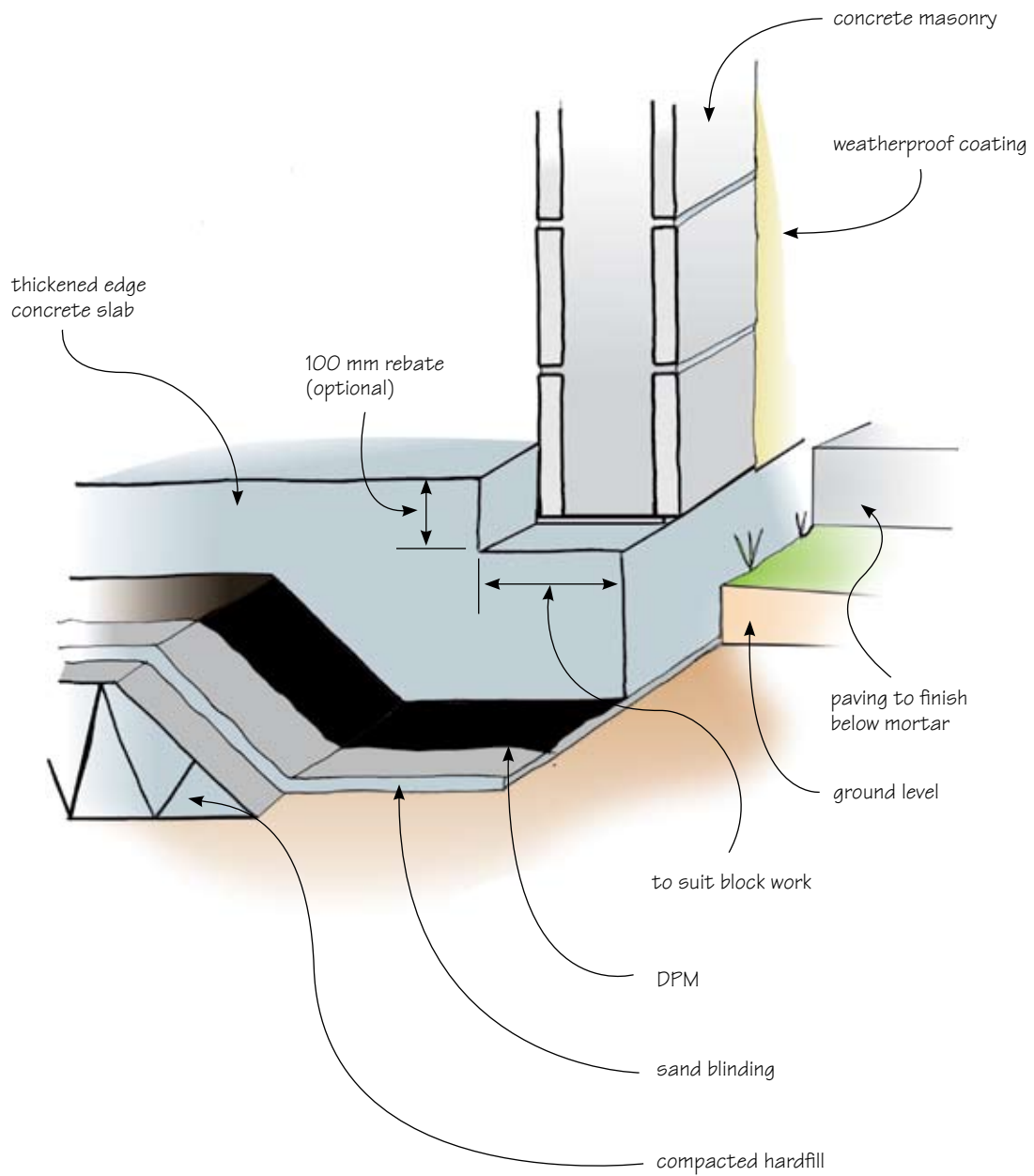
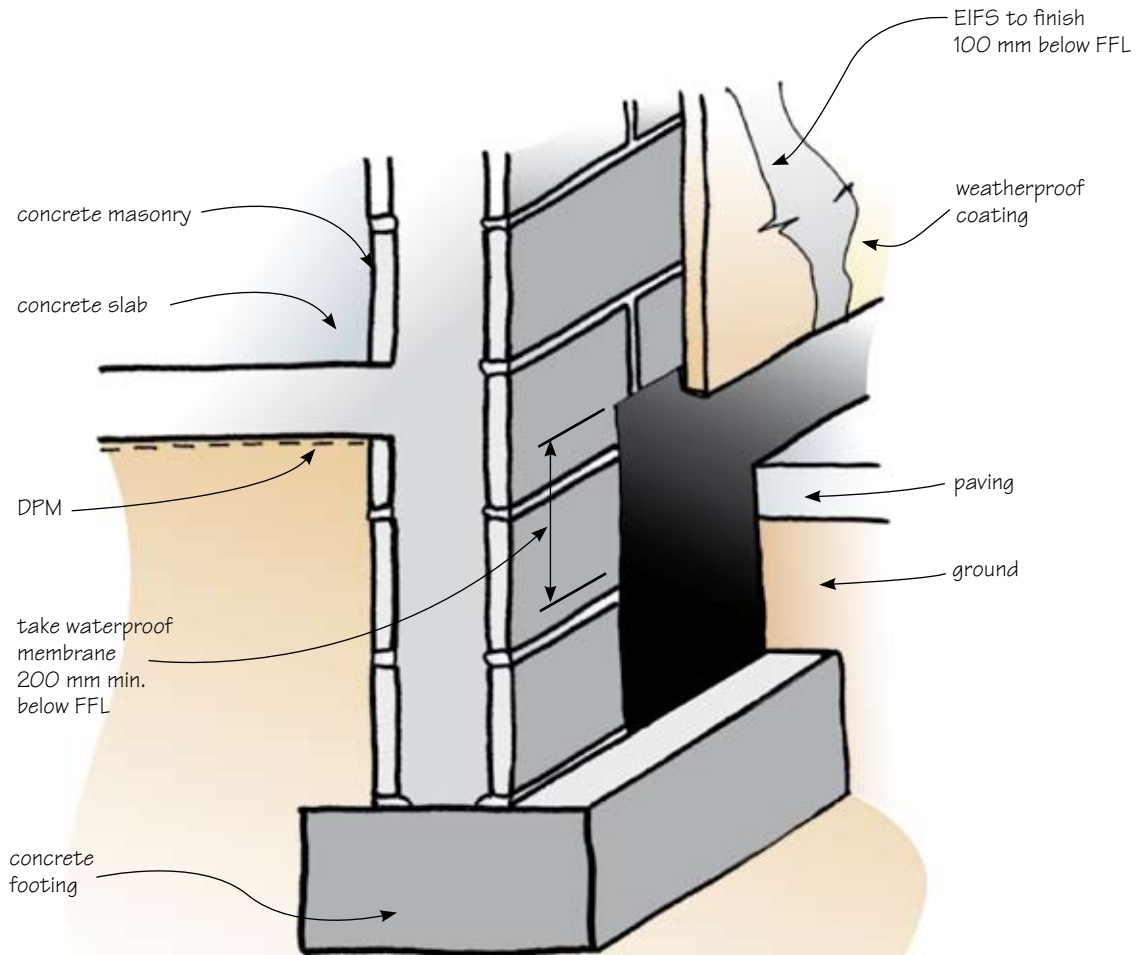
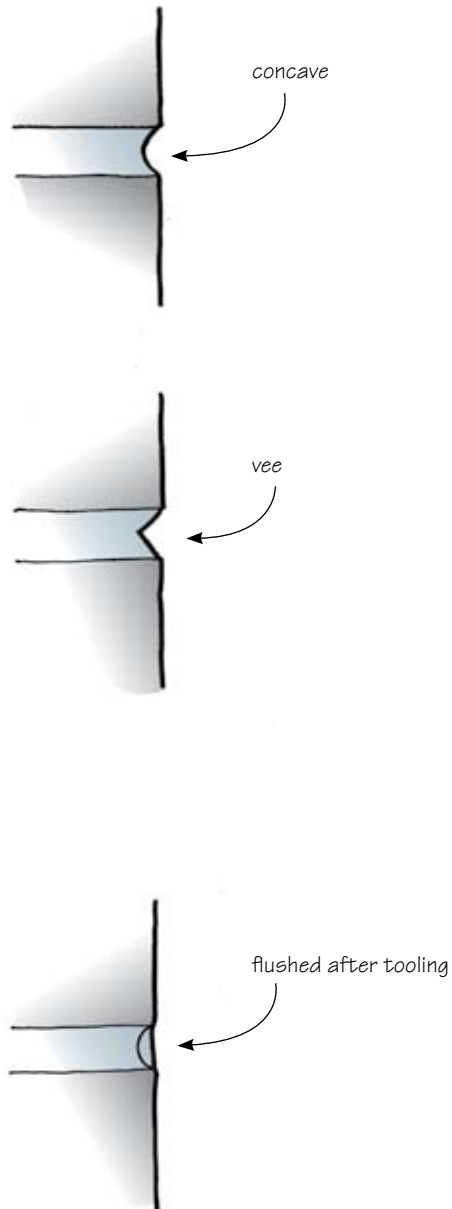


Figure 13. Continuous masonry



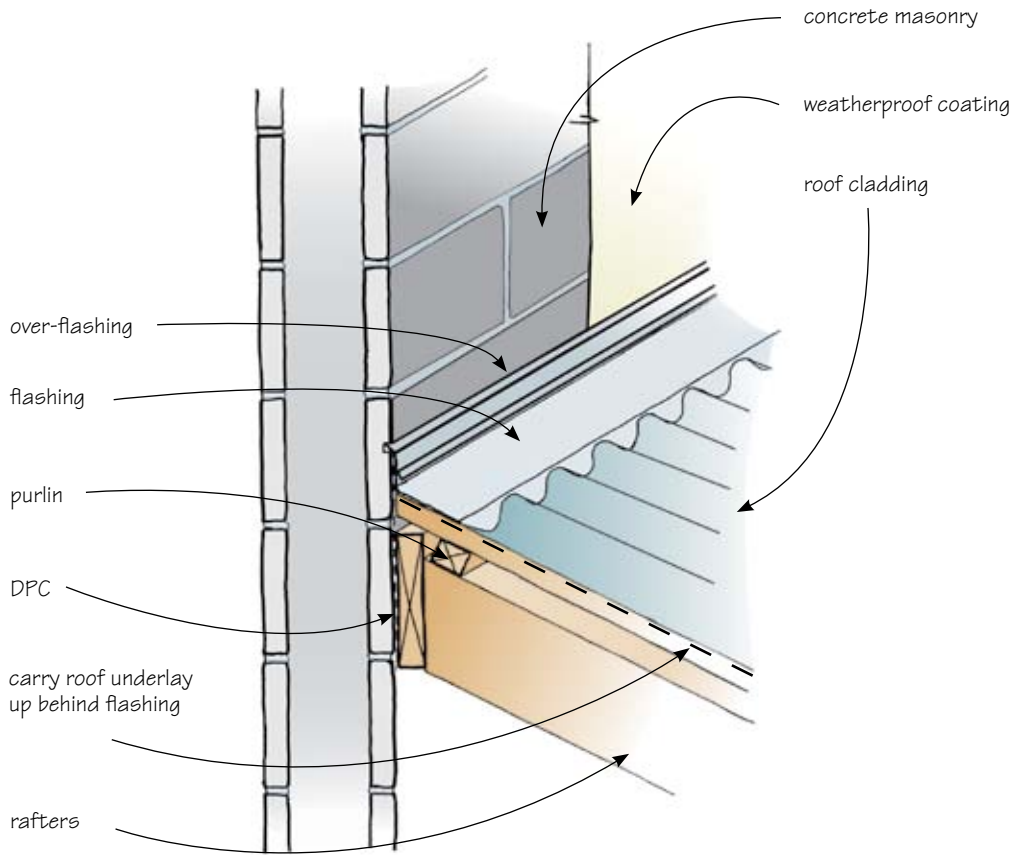
\* Note: Plaster to finish 100 mm min. below slab level and above G.L.

Figure 14. Preferred mortar joint profiles



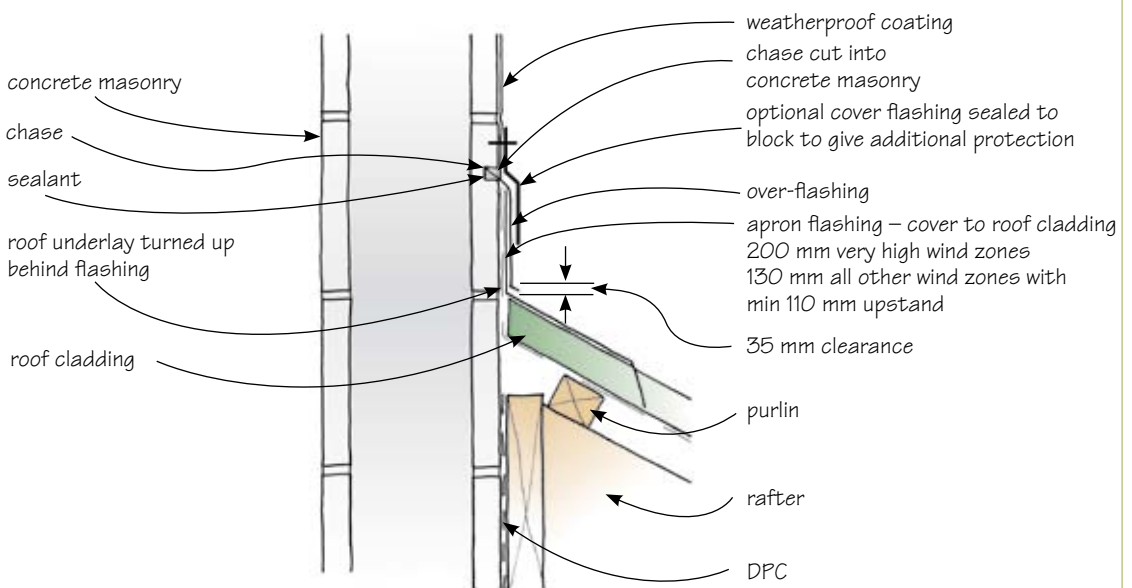
Note: All joint profiles – to be tooled and retooled

Figure 15. Wall-to-roof junction



Note: Fold and seal flashing around internal and external corners

Cross-section of wall-to-roof junction



### 3.11 Weatherproof coating systems

There are six coating systems for concrete masonry outlined below:

- clear coating
- applied waterproof membranes
- water-borne paint or high-build (acrylic) coating
- polymer-modified cement plaster and weatherproof coating
- cement plaster and weatherproof coating
- insulation, polymer-modified cement plaster and weatherproof coating.

For further recommendations about the application of weatherproof coatings, refer to Section 3.12.

#### 3.11.1 Clear coatings

Clear coatings are not usually recommended because of the difficulty in achieving sufficient coating penetration into masonry to give satisfactory weatherproof performance.

#### 3.11.2 Applied waterproof membranes

Suitable materials for use as an applied waterproof membrane include:

- acrylic paint
- high-build acrylic
- bitumen emulsion if compatible with subsequent coatings
- paint-on cementitious coating.

#### 3.11.3 Paint or high-build acrylic

Applying a weatherproof coating directly onto concrete masonry reduces costs and enables the block nature of the wall to be expressed. Blocks and grout fill must be allowed to cure and dry before application of any coating.

It is recommended that weatherproof coatings applied directly to the concrete masonry are water-borne dispersion coating to give 180 – 250 micron dry film thickness. (NZS 4229)

High-build acrylic coatings, compared to paint coatings, have:

- significantly greater finished film build
- enhanced ability to bridge small cracks
- generally more durability
- generally less breathable, so can limit drying.

Also, depending on the formulation, high-build acrylic coatings may:

- fill cracks and voids
- be applied in thick layers
- provide a textured finish to the surface.

#### 3.11.4 Polymer-modified cement plaster and weatherproof coating

This is the coating typically applied over polystyrene. It can also be applied directly to the concrete blocks.

Polymer-modified cement plaster comprises sand, cement and polymer (usually acrylic-based). This enables better curing with less water being used.

A weatherproof coating must be applied over polymer modified cement plaster.

### 3.11.5 Cement plaster and weatherproof coating

Applying a cement plaster coating to the concrete masonry before the application of a weatherproof coating:

- provides a denser, smoother surface for weatherproof coating adhesion than unplastered concrete masonry
- covers mortar joints
- enables corners to be chamfered, reducing the likelihood of the weatherproof layer cracking.

If possible, employ an accredited applicator with a manufacturer's guarantee.

When plastering, the air temperature must be above 5°C, yet not so hot that drying is too rapid, which can lead to cracking.

There is a wide range of surface finishes available, ranging from an undulating finish (achieving a rustic look) to straight plaster finishes (the smoothest type of finish available). The thicker the coating system, the greater the range of surface finishes are possible.

The best surface finish for solid plaster for weathertightness is as smooth as possible, as this ensures even coverage. A smooth finish avoids the problems rougher surfaces can have with the coating being thinner on the crests and the risk of the coating not being able to access crevices.

As plaster is porous, a weatherproof coating must be applied over it. It is recommended that the weatherproof coating be water-borne, as per the previous section.

### 3.11.6 Insulation, polymer-modified cement plaster and weatherproof coating

This system is also known as EIFS (exterior insulation and finish system).

1. The insulation panels (typically rigid polystyrene sheets) are adhered or mechanically fixed to the concrete masonry
2. A modified plaster is then applied (usually in conjunction with a fibreglass mesh) to the insulation panels
3. A weatherproof coating is then applied to the plaster.

The EIFS system must be from a single manufacturer applied by a Proprietary Plaster Cladding System (PPCS) trained applicator.

## 3.12 Weatherproofing application

Concrete masonry or a cement plaster finish must have a weatherproof coating designed for application to cementitious surfaces applied to all exterior surfaces including rebates. This is due to the porous nature of the units, and because cracks can develop between the units and the mortar.

Coatings may need to be maintained more often when exposed to the following environmental factors:

- greater rainfall
- seaspray
- geothermal gases
- industrial gases.

Having a roof overhang is an important mitigating factor in reducing the amount of water on any wall surface (see Figure 1).

### 3.12.1 Weatherproofing issues

When applying a weatherproof coating to concrete masonry address these issues:

- cleanliness of the substrate
- dryness
- air temperature and weather
- film build
- coats
- durability – under NZBC B2 durability of individual exterior paint coatings must be at least five years.

#### Cleanliness

Ensure the blockwork is clean and free from surplus mortar/block-fill. All mortar joints should be free from dags, and units should have smooth, clean surfaces. To achieve this, brush the surface of the wall down with a wire brush, or rub a piece of masonry on it. The concrete masonry needs to be dust-free prior to plastering or painting. Rub with a clean black cloth to check if clean.

The concrete masonry needs to be free of any contaminants that will interfere with the ability of the plaster or paint to adhere. This includes:

- tar and bituminous emulsions, use scouring powder and water to remove
- soil and clay (brush off when dry).

Commercial degreasing agents can also be used. Chilling the surface with ice will make contaminants more brittle and easier to chip off. Surface laitance must be removed – brush off.

#### Dryness

Before coating, concrete masonry must be dry with a measured RH (relative humidity) of 70% or less.

AS/NZS 2311 recommended drying times for recently constructed masonry are:

- eight weeks for solid-filled construction
- four weeks for partially-filled construction.

Painting should not occur in damp conditions – rain, high humidity, fog, frost, heavy dew or when rain is likely.

#### Temperature

When painting, ensure that the air and substrate temperatures are between 10°C and 30°C. Mornings are the better time to paint if it is not damp. It is also better to paint and plaster on shaded walls. Painting in hot weather can cause a rapid loss of solvent or water, reducing the cohesion properties of the paint, resulting in patchiness and blistering.

#### Film build

The coating system needs to be thick enough to give protection to the concrete masonry, yet runny enough in its liquid state to be able to penetrate voids and crevices in the surface of the blocks.

Two or three coats are needed to give the required film build, depending on the product and texture of the surface (see Section 3.11.3). This enables the concrete masonry to be completely coated; any omissions in the first coat being covered by the second. This is also to achieve the required dry film thickness.

Paint must be worked into the surface to fill voids and pin holes.

### Other considerations

When considering the finishing of exterior surfaces:

- bagging the walls fills any voids in the concrete masonry ensuring better coverage by the waterproofing system
- as with all claddings, light colours are preferred on concrete masonry as there is reduced risk of heat build-up leading to cracking occurring in the waterproofing system.

## 3.13 Basements

Waterproofing is needed on basement walls to prevent moisture being absorbed into them (see Figure 16).

Prevent groundwater reaching any concrete masonry wall below finished ground level by:

- draining the subsoil to decrease the hydrostatic pressure on the basement waterproofing
- providing channels or drains to divert stormwater draining to the basement area
- sloping the ground away from the building – minimum 1:25 for at least 1 m.

The concrete masonry must be completely clean and smooth, and priming may be required before the waterproofing system chosen is applied.

Basement waterproofing generally requires a durability for the life of the building – but not less than 50 years.

### 3.13.1 Damp-proof membranes and tanking

**Damp**-proof membranes (DPMs) refers to waterproofing material below slabs. These are typically sheet systems placed over a layer of sand blinding which is over compacted granular hard-fill (see Figure 12).

Where a site concrete has been constructed before pouring the main slab, a liquid system meeting a 50 year durability requirement instead of a sheet system may be applied to the site concrete.

Tanking typically refers to the system of waterproofing applied to walls, particularly walls below ground, and to floors. These can be liquid systems applied directly to the walls or a sheet material against the walls. Both usually need some method of support and protection.

The intersection between DPM and tanking needs to be sealed. Check compatibility of DPM and tanking with product manufacturers.

### 3.13.2 Sheet and liquid systems

**Sheet systems** are:

- polyethylene (usually known as polythene – the most commonly used waterproofing under slabs)
- modified bitumen sheet (torch-on or self adhesive)
- bitumen and tar emulsions
- polymer (polythene) and combination polymer
- self-adhesive polythene/bitumen composites
- clay (bentonite).

Ensure material specified is able to be:

- folded and sealed at corners
- sealed around penetrations

- sealed to the tanking or DPM material chosen
- used under basement slabs according to manufacturer's specifications.

Reinforced fillets or chamfers are recommended at corners.

**Liquid systems** are based on:

- epoxies
- polyurethane
- bitumen and tar emulsions

**Epoxy systems** – epoxy-based systems are resistant to attack by fuels, oils and solvents, but have limited flexibility.

**Polyurethane systems** – polyurethane-based systems are not resistant to fuels, oils or solvents, but have good flexibility and elongation properties.

**Bitumen and tar emulsion systems** – may need to have corners reinforced with fibreglass. These systems can be damaged by fuels, oils and solvents.

**Liquid systems** – are more variable than sheet materials in their crack-bridging and structural movement capacities. They are also reliant on the skill of the operator for correct coverage.

### 3.13.3 Protection

Protection to sheet and liquid systems can be provided with lightweight rigid sheeting such as:

- plywood treated to H3.2
- flute board (extruded plastic as used for sign boards)
- polystyrene boards
- fibre-cement sheeting.

Alternatively, protect the waterproofing with a proprietary drainage mat and protection sheet which allows water to drain to the foot of the wall. These are either:

- manufactured from extruded polyethylene sheets with raised studs or
- a moulded open PVC or polypropylene grid combined with a geo-textile mat.

## 3.14 Window and door openings

If a building is going to leak, a common cause is inadequate detailing and installation around window and door frames.

### 3.14.1 Direct-fix

Where windows and doors are being detailed, they need to follow direct-fix principles:

- the joinery is bedded to the concrete masonry in sealant along the back of the jamb and head flange to set the back of the window flange 3 – 5 mm forward of the finished rebate.
- the sill is not bedded in sealant but left open – to give a 3 – 5 mm gap
- a continuous air seal is to be provided to the inside around windows, doors and penetrations.

### 3.14.2 Waterproofing

For both windows and doors, it is imperative that the opening in the concrete masonry for the joinery is thoroughly waterproofed before installation (see Figure 7).

The applied waterproofing membrane is to be applied as shown in Figures 2 and 6.

For blocks without rebates, the applied waterproofing membrane is to be applied 50 mm over the outside face of the concrete masonry, then right across the whole of the inside face of the block (Figures 17, 18, 19 and 20, see Figure 3), except where a natural concrete masonry finish is required on exposed internal concrete masonry surfaces (see Figure 7).

A proprietary corner soaker for aluminium windows to drain mitre corners is recommended.

For door sills, the applied waterproofing membrane is to be applied 50 mm over the outside face of the concrete masonry, then:

- over the slope formed in plaster below the sill (see Figure 10)
- between the footing and the slab or within the slab itself if a rebate is used (see Figure 10)
- up the jambs for 100 mm.

### 3.14.3 Rebated blocks

The preferred detail for windows and doors is to use:

- rebated blocks for the head and jambs
- rebated and sloped sill blocks for the windows.

Rebated blocks may be less suitable for use with:

- door sills – timber and aluminium joinery
- timber joinery – windows and doors
- aluminium joinery used in conjunction with EIFS.

### 3.14.4 Rebates for doors

Rebates for doorways are as indicated on the Figures for doors (Figure 21 and see Figure 10). While a 100 mm rebate is recommended but not essential for the exterior concrete masonry walls, a shallower rebate is generally required for doorways, depending on the type of sill profile specified (see Figure 10).

### 3.14.5 Joinery with claddings

#### Plaster and paint finish

For timber window and door details in plaster and paint finishes, refer to Figures 10 and 17.

For aluminium window and door details in plaster and paint finishes, refer to Figures 2 and 6.

#### EIFS

For timber window and door details in EIFS, refer to Figure 18.

For aluminium window and door details in EIFS, refer to Figures 3, 19, 20 and 21.

## 3.15 Penetrations

Care must be taken that adequate weathertightness is maintained around meter boxes (Figure 22). Locating meter boxes in a sheltered position is recommended.

Penetrations such as pipes also need to be correctly detailed (Figure 23).

### 3.16 Different claddings

Where concrete masonry abuts a different cladding, have a back flashing (with a hook) behind the cladding, which is then embedded in sealant in a saw cut in the concrete masonry (Figure 24).

### 3.17 Maintenance

#### 3.17.1 Weatherproofing

The weatherproofing system needs to be regularly maintained – involving the removal of dirt, mould and other organic deposits, the repair of cracks or other defects, and recoating as necessary.

#### 3.17.2 Sealants

Minor defects in the sealant need to be cut out and replaced. Mould growth also needs to be removed by brushing with a dilute neutral detergent solution. Do not use solvents, bleaches or abrasives on sealants.

Sealants over time lose flexibility. Sealants that split or lose adhesion at the sides of the joint must be replaced as soon as a defect is noted.

Figure 16. Basement

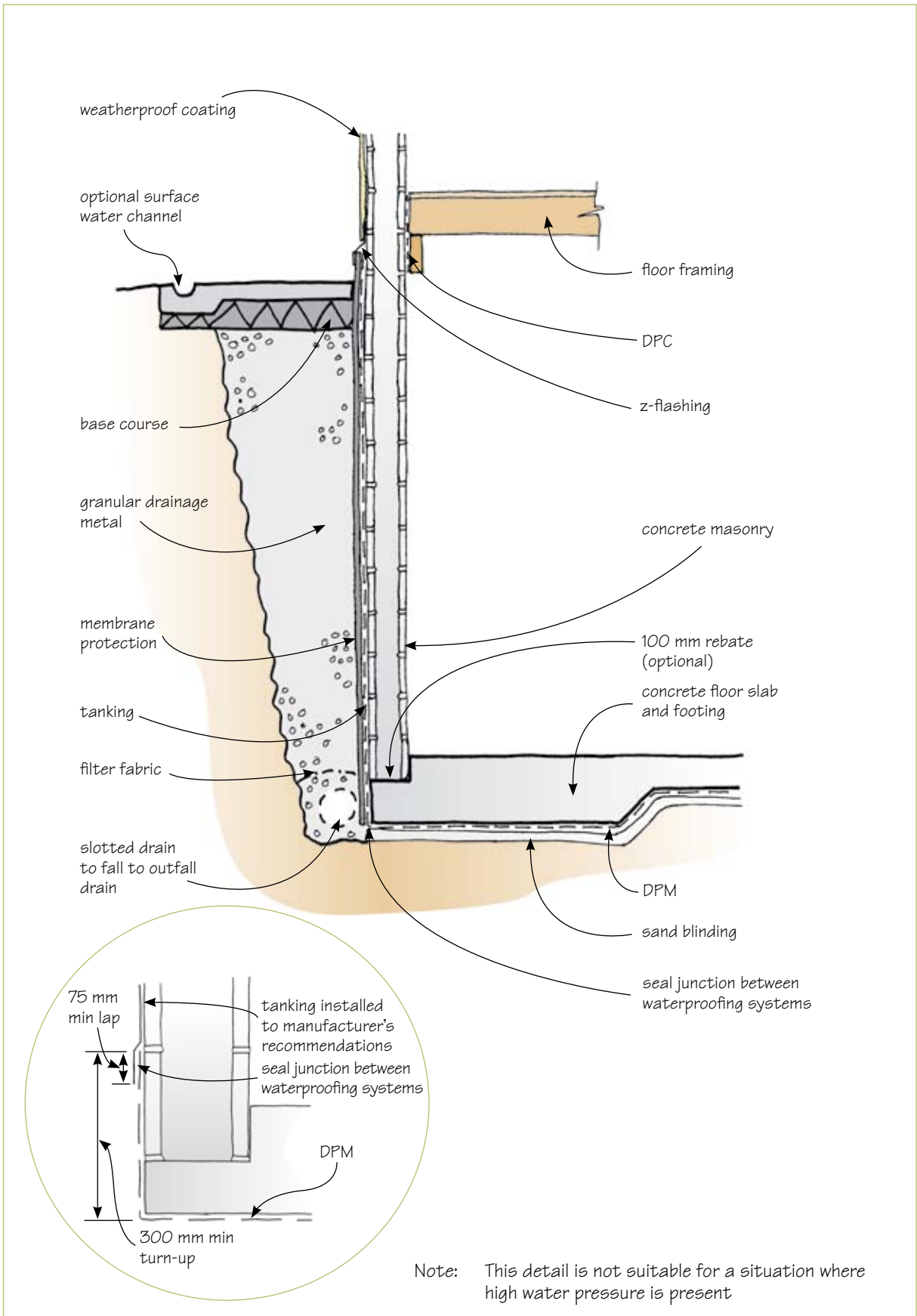
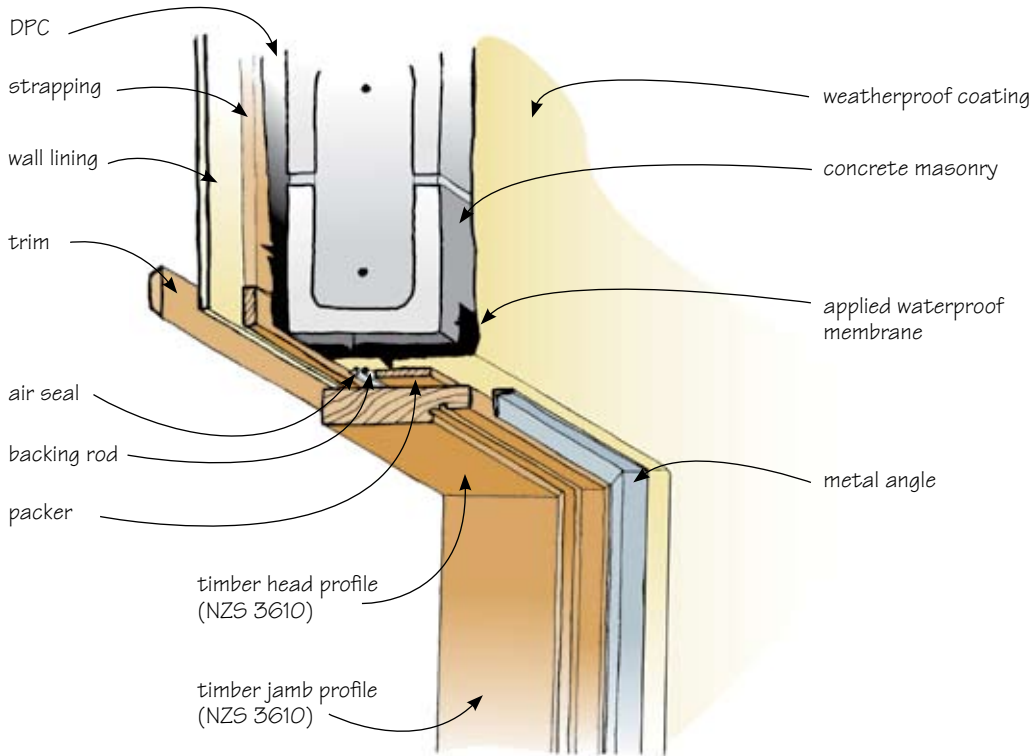
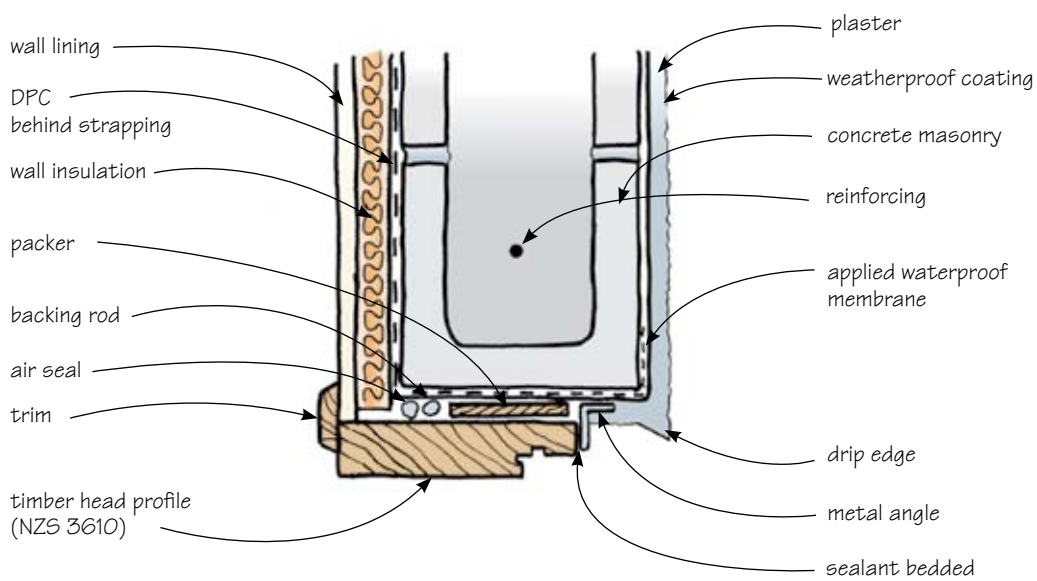


Figure 17. Door head – plaster or paint

Door head – paint (jamb similar)

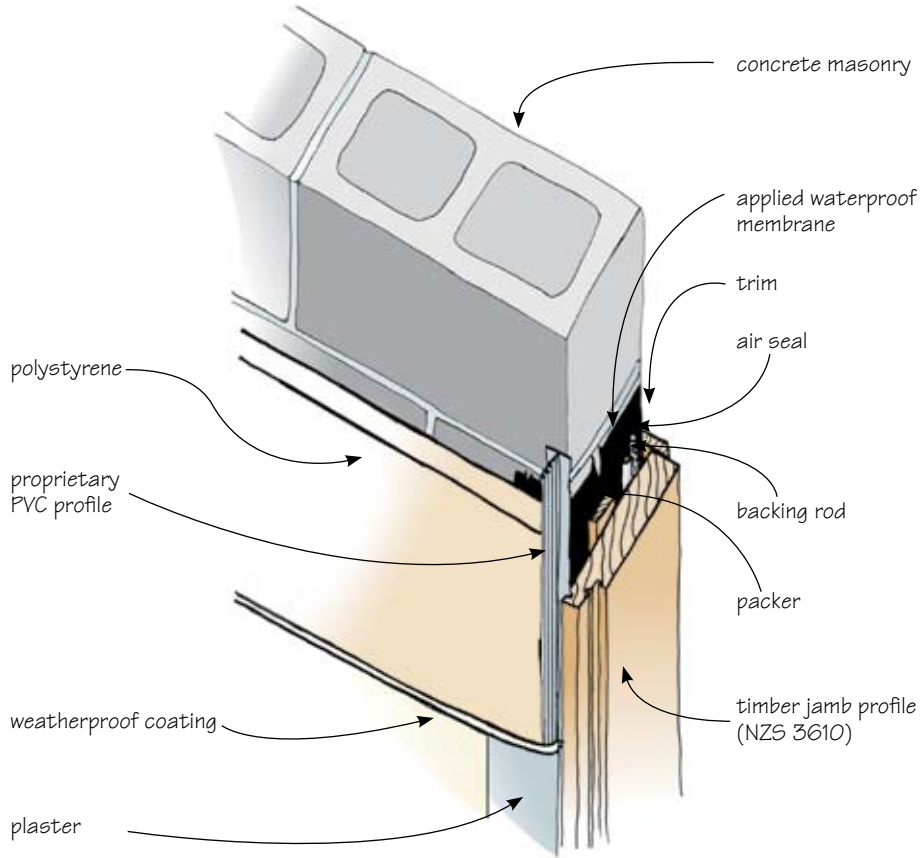


Cross-section of door head – plaster (jamb similar)



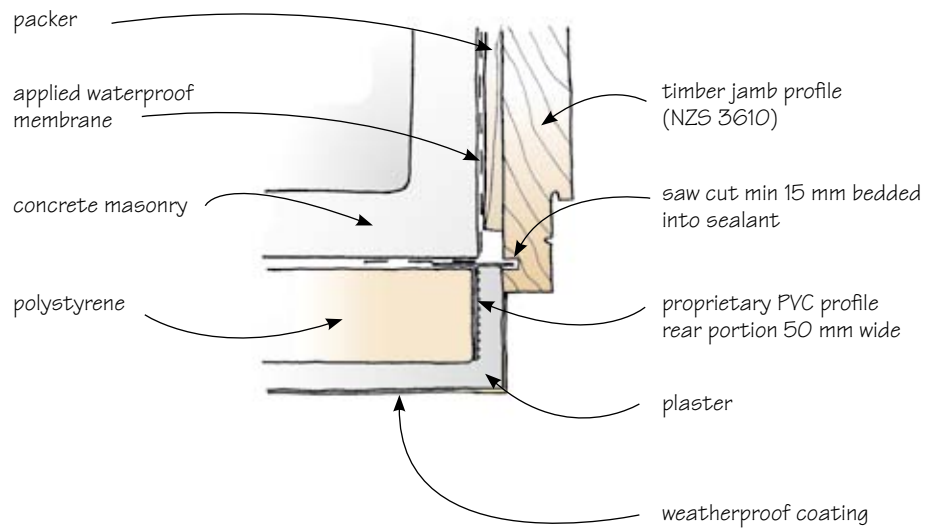
Note: Refer Figure 10 for sill detail

Figure 18. Door jamb – EIFS

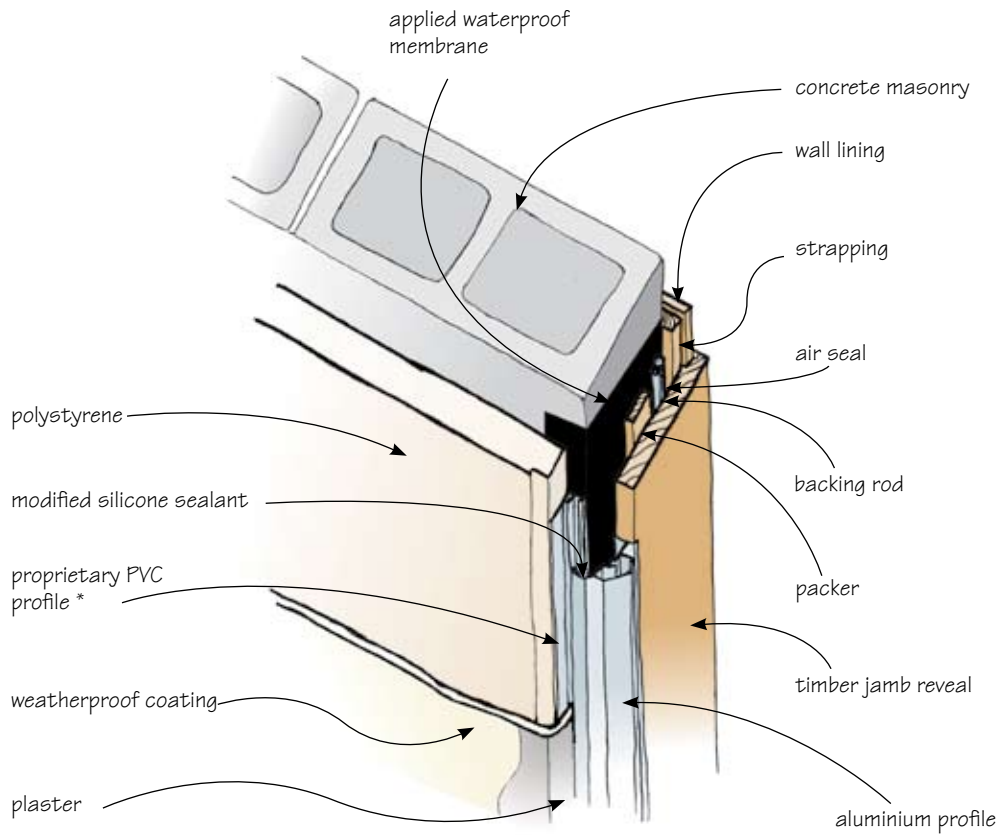


Note: Insert door frame before EIFS uPVC trims

Cross-section of door jamb – EIFS

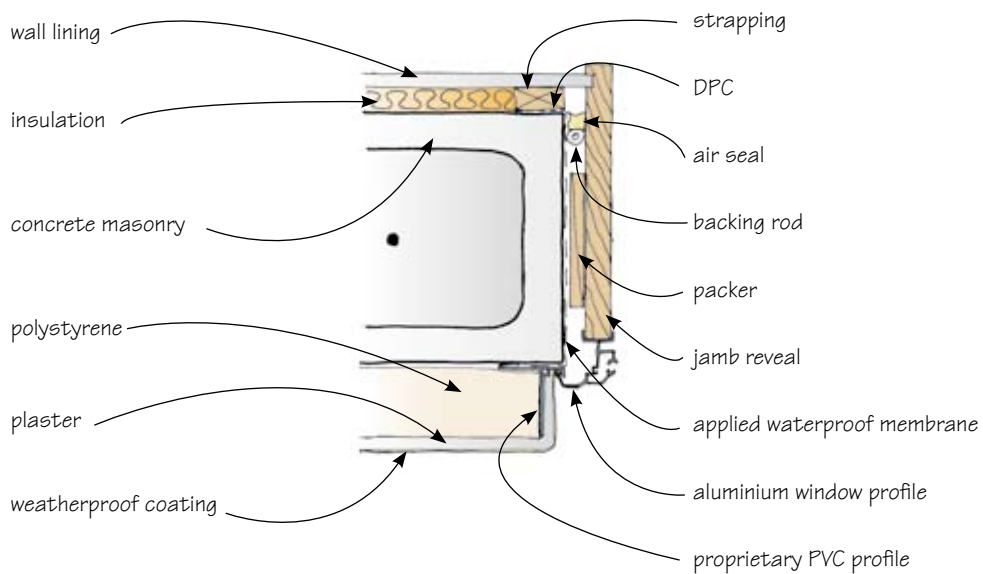


**Figure 19. Window jamb – EIFS**



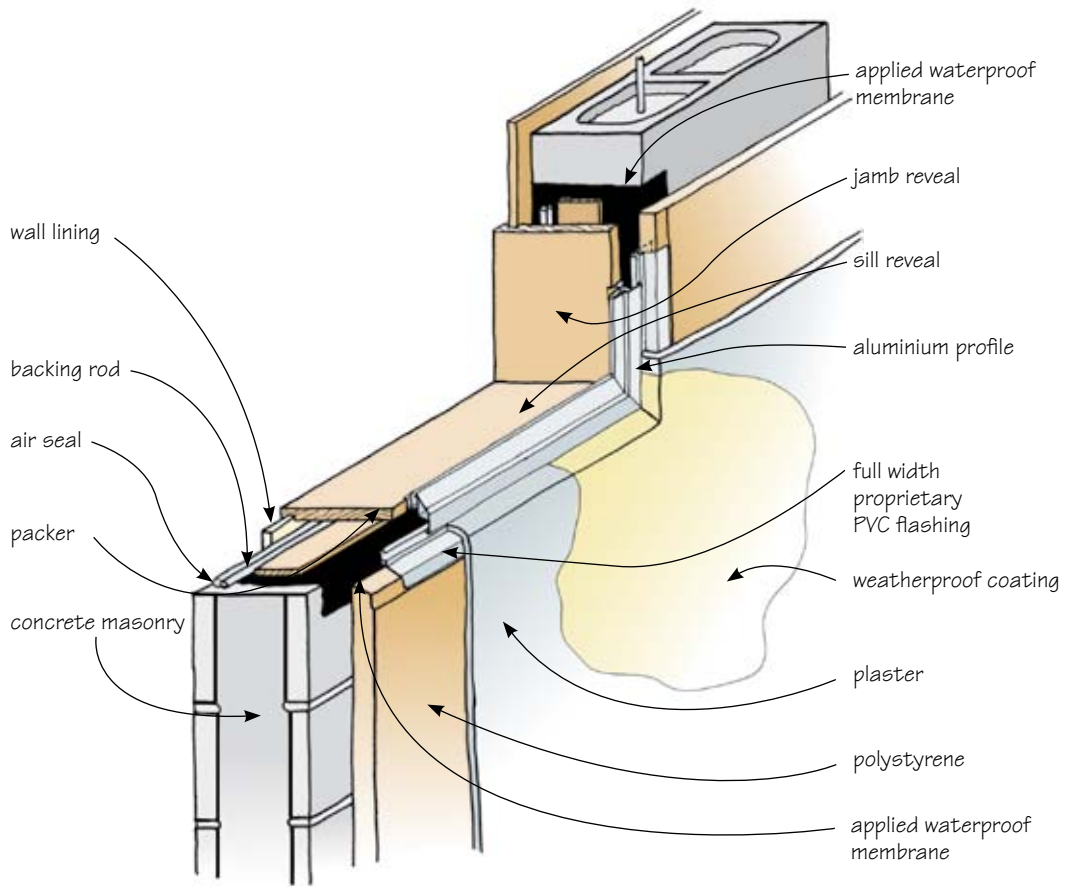
\*Note: Vertical profile needs to be taken to the head of the window

**Cross-section of window jamb – EIFS**

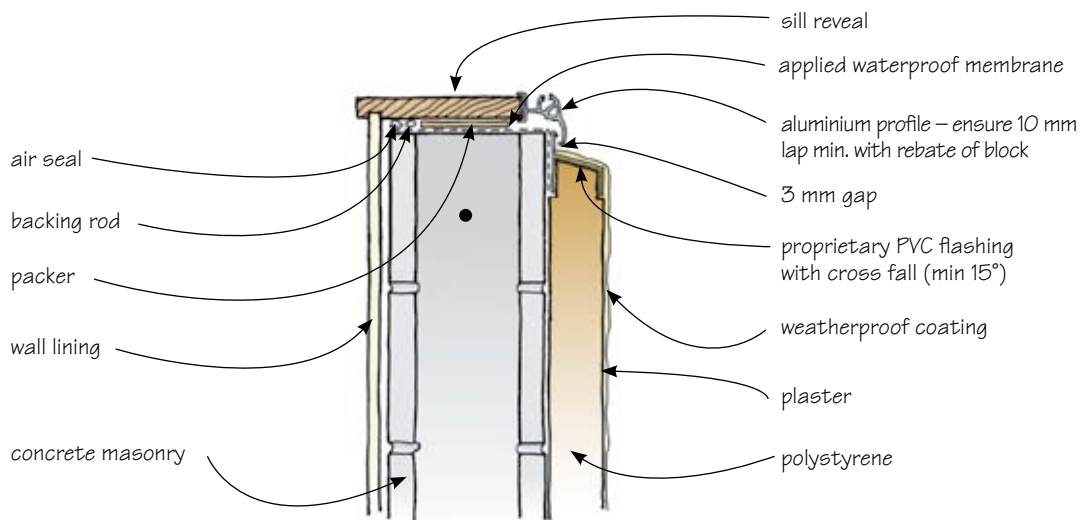


Note: Refer Figure 3 for head detail, Figure 20 for sill detail

Figure 20. Window sill – EIFS

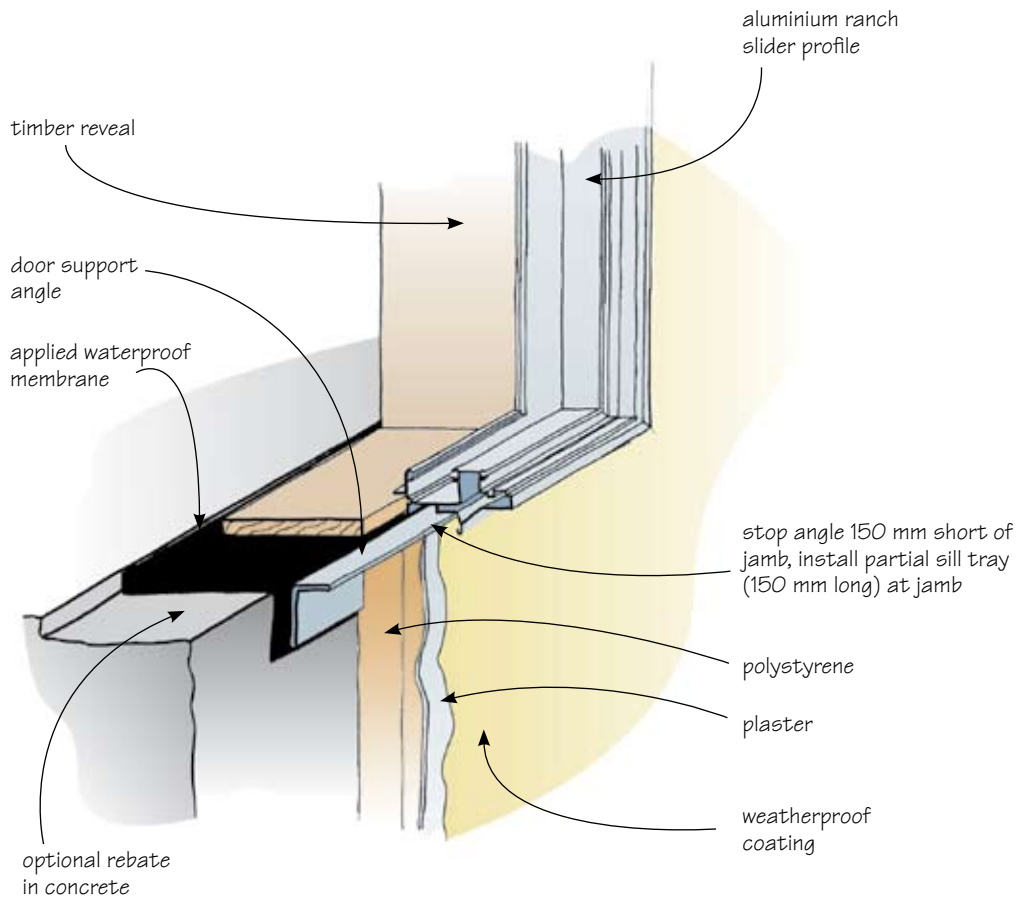


Cross-section of window sill – EIFS



Note: Refer Figure 3 for head detail, Figure 19 for jamb detail

Figure 21. Door sill – EIFS



Cross-section of door sill – EIFS

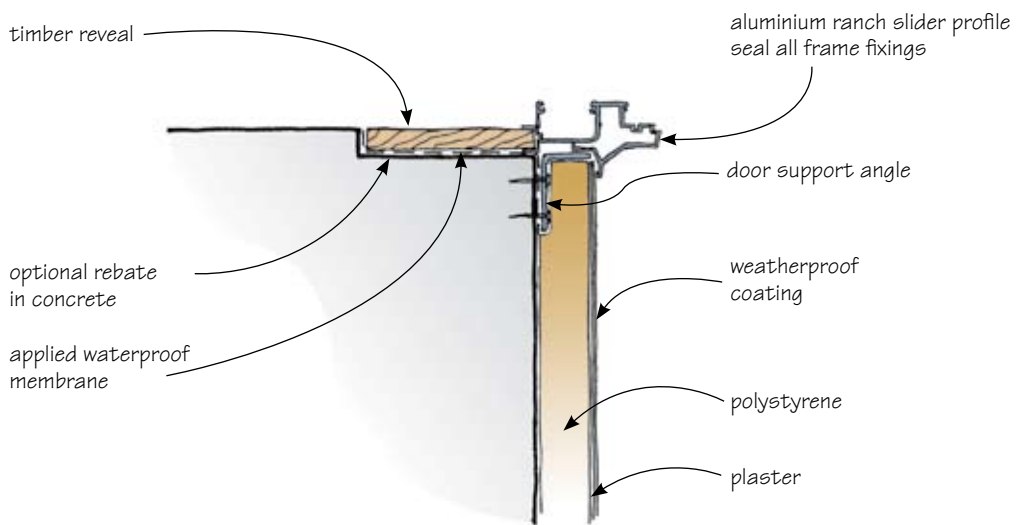


Figure 22. Meter box

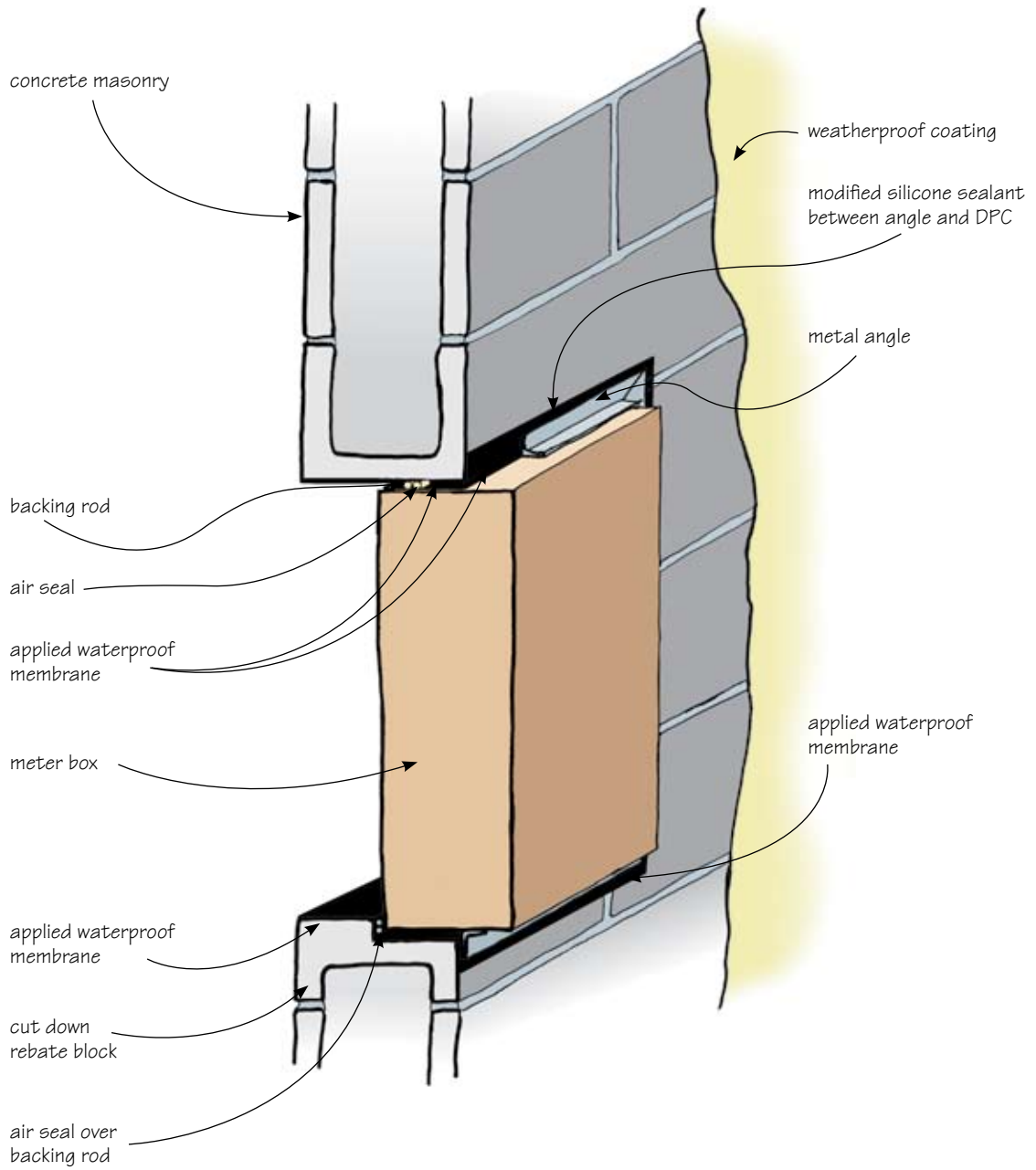
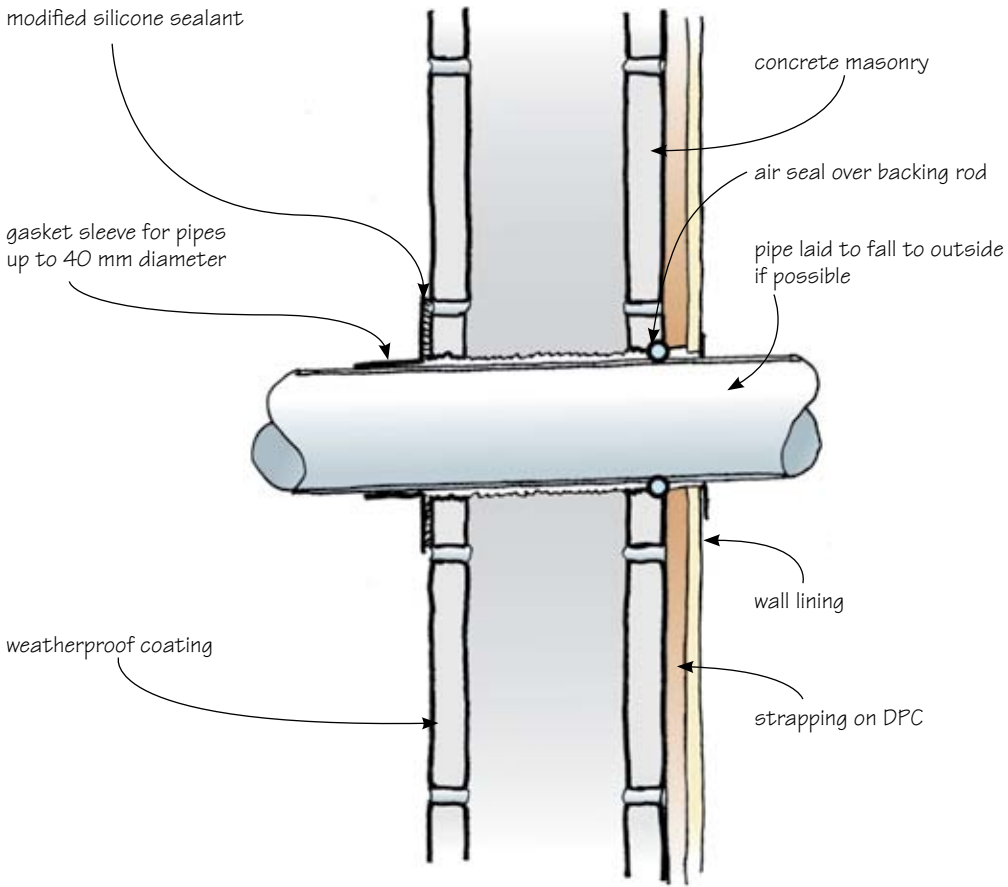
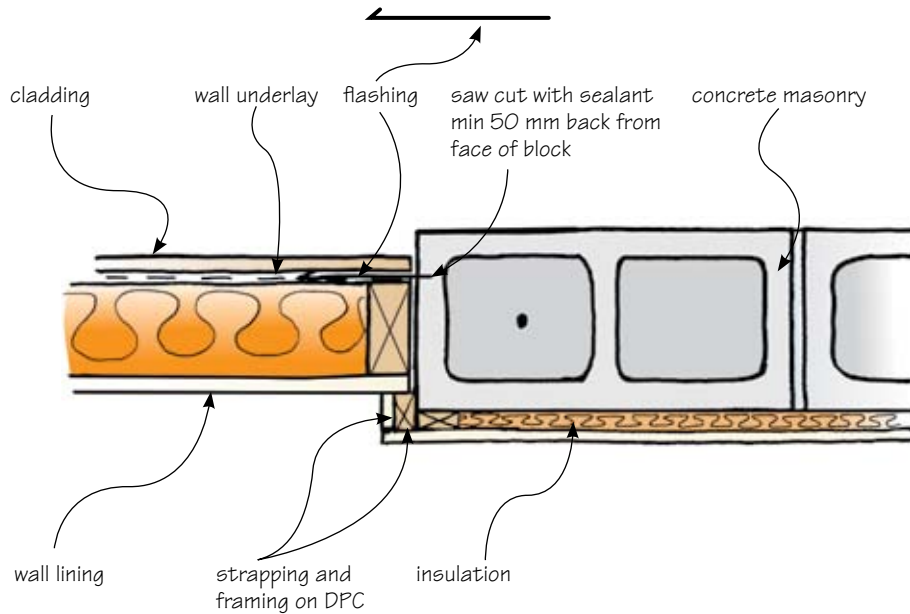


Figure 23. Pipe penetration

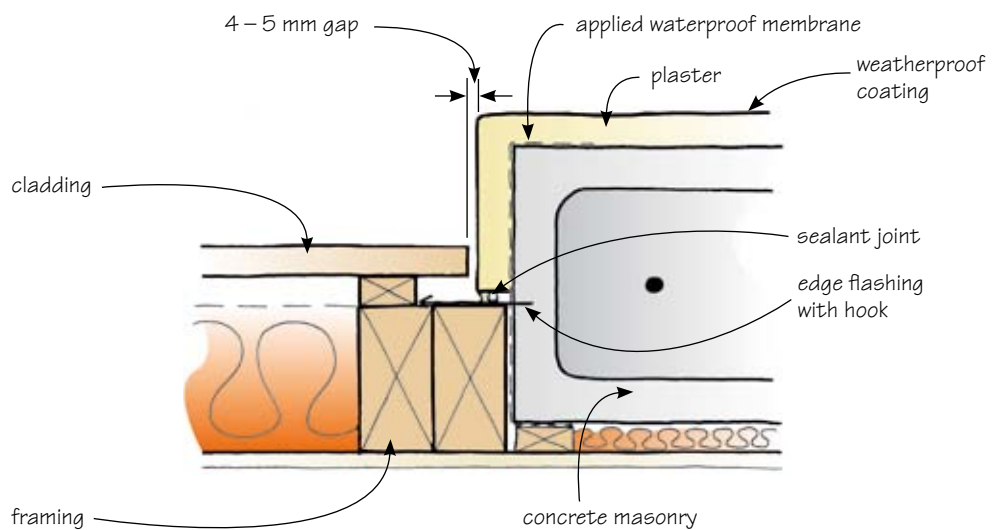


**Figure 24. Concrete masonry adjoining other claddings**



Note: Flashing must be selected to give at least 15 year durability

### Alternative detail



# GLOSSARY

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4

<b>accredited applicator</b>	An installer/applier who is approved by the manufacturer of a product to install/apply that product
<b>acrylic</b>	Common name for thermoplastic materials based on resins formed by acrylic monomers, such as ethyl acetate or methyl methacrylate
<b>air flow</b>	Movement of air through a gap in the building fabric
<b>air seal</b>	A continuous seal fitted between a window, door reveal or similar wall penetration and the surrounding wall to prevent the flow of air into the interior of the building
<b>alkaline</b>	Having a pH value of greater than 7
<b>Alternative Solution</b>	Design proposal with supporting evidence that has been consented by a BCA and that is outside the scope of an Acceptable Solution
<b>applied waterproofing membrane</b>	Material (sealer) put on a surface to render it impervious to water
<b>backing rod</b>	A compressible material inserted to contain a (typically expanding) air seal or sealant joint
<b>blinding</b>	Sand used to smooth the surface of a compacted base course to protect a DPM from puncturing
<b>block-fill (grout)</b>	A free-flowing mix that is able to penetrate all the voids in concrete masonry (see grout)
<b>blow-out</b>	Occurs when a block face fails due to excessive pressure during grouting
<b>bond breaker</b>	A material to which sealant will not adhere
<b>capillary action</b>	Process where water is drawn between two surfaces which are sufficiently close together
<b>cavity system</b>	(See drained and vented cavity)
<b>chamfer</b>	A corner bevelled at 45°
<b>cohesion</b>	The internal bond that holds a material together
<b>compacted hardfill</b>	Graded shingle (metal) or similar material that has been packed down to be a base course under concrete foundations, floor slabs or under paved surfaces
<b>compressive strength</b>	The measured maximum resistance of a concrete or mortar specimen to axial loading expressed as force per unit cross-section area (MPa)
<b>concrete masonry</b>	Pre-formed hollow concrete units

<b>consolidation</b>	The process by which grout particles are packed more closely together by vibration or rodding
<b>control joint</b>	A joint or gap constructed to accommodate movements
<b>cover (concrete)</b>	Amount of concrete between the reinforcing steel and the surface of the element
<b>cover (flashing)</b>	Dimension by which two building elements overlap
<b>crack-bridging</b>	Ability of a coating to remain intact over small cracks in the substrate
<b>curing</b>	The process of strengthening of mortar, grout, concrete, plaster, glue or paint, through physical or chemical change
<b>dag</b>	Lump of mortar proud of the surface of the blocks – internally or externally
<b>debonded</b>	Lack of adherence between two materials or components
<b>direct-fix cladding</b>	A wall cladding attached directly to the wall framing, without the use of a drained and vented cavity
<b>DPC</b>	Damp-proof course – a narrow width of impervious material placed between building elements to prevent the passage of moisture from one material to another (typically between concrete or concrete masonry and timber)
<b>DPM</b>	Damp-proof membrane – sheet material or coating having a low water vapour transmission and used to prevent water penetration into buildings – typically used beneath concrete slabs
<b>drained and vented cavity</b>	A cavity space, immediately behind a cladding, that has vents at the base of the wall allowing water which occasionally penetrates the cladding to drain to the exterior and any remaining moisture to dry by evaporation
<b>drip edge</b>	Fold(s) applied to the edge of a horizontal flashing or a protruding surface (e.g. built-up plaster) which breaks surface tension and deflects moisture away
<b>durability</b>	The length of time a product or system is able to perform, or the resistance of a product to deterioration
<b>efflorescence</b>	The formation of a crystalline deposit on the surface of concrete, masonry or plaster due to the evaporation and crystallisation of the alkaline salts which may be contained in the building materials
<b>EIFS</b>	Exterior Insulation and Finish System – a polystyrene sheet-based cladding system that uses mesh reinforced polymer-modified cement-based plaster base coats and a weatherproof coating
<b>elongation</b>	Ability of a material to be stretched
<b>expansive admixture</b>	A material added to mortar that causes it to expand, ensuring all voids within concrete masonry are filled
<b>fibreglass mesh</b>	Composite material of synthetic fibres which is used to reinforce the plaster in the EIFS system
<b>fillet</b>	Small angle moulding or strip formed in wood, concrete, mortar or plaster
<b>flashing</b>	A rigid or flexible waterproof material, formed to drain or deflect water away from critical junctions

<b>flood-applied</b>	Where a product is poured over an element
<b>gasket sleeve</b>	A piece of deformable material, pre-shaped, to make an effective seal at a joint
<b>gauge boxes</b>	A wooden box used for measuring ingredients by volume to ensure accurate ratios are achieved
<b>grout</b>	A highly workable mixture of cement, sand, aggregate (up to 13 mm but typically 7 mm) and water, sometimes with chemical admixtures, forming a pourable liquid (slurry) which will flow easily without segregation of the ingredients. Used to fill concrete masonry cells after block laying completed
<b>high-build</b>	A specially formulated coating, that allows a relatively thick film to be applied in a single coat without running or sagging
<b>hydrostatic pressure</b>	The pressure of water imposing a force on an element, such as a basement wall
<b>immersion vibrator</b>	Oscillating machine immersed in mortar to assist compaction
<b>insulation</b>	A material that has a thermal conductivity of less than 0.07W/m°C
<b>junction</b>	Join between two building materials or elements
<b>laitance</b>	A layer of scum or whitish deposit containing cement and fines brought to the surface by bleeding of overwet and/or overworked grout
<b>levelling course</b>	First course of concrete masonry where the mortar is laid on takes up the construction tolerances, to ensure the course is level
<b>lift</b>	The height of grout that is poured in one continuous operation
<b>liquid system</b>	A material that is applied in its viscous form
<b>low modulus of elasticity</b>	A material that does not deform (stretch or bend) readily
<b>masking</b>	Temporary covering of a surface to protect it from adjacent work
<b>masonry veneer</b>	(See veneer)
<b>metal drip angle</b>	A horizontal member made of metal to form a drip edge, usually above windows and doors (see drip edge)
<b>moisture barrier</b>	A material in sheet or membrane form which prevents penetration of moisture into a building
<b>mortar</b>	A suitably proportioned plastic mixture (paste) of sand (fine aggregate), cement and/or lime, and water, with or without additives or chemical admixtures, used for the laying of concrete masonry units and which bonds them together after hardening
<b>neutral cure</b>	A product that does not need acid to cure or 'set'
<b>non-specific design</b>	A design which does not require specific engineering calculations and design
<b>open time</b>	The length of time a product will still be useable after mixing or opening
<b>packer</b>	Any material used for filling, levelling or making solid under or between members

<b>partially-filled</b>	The practice of grout filling cells containing steel reinforcement, while other cells are left empty
<b>plaster</b>	A combination of sand, cement and water that when mixed with water forms a plastic mass which sets or hardens after application to a surface
<b>polymer-modified plaster</b>	A cement plaster with a polymer additive (usually acrylic-based) to enable better curing with less water usage
<b>primer</b>	The first complete coat of a painting system applied to an unpainted surface – a primer seals the surface to give even porosity and provide a key for succeeding coats
<b>proprietary</b>	A product registered, described or sold under a trade name
<b>rebate</b>	Recess formed along the edge or cut into the surface of a material or element for the fitting of a frame, door, sash or other component
<b>reflected</b>	Where a fault occurs in a lower layer, or in the substrate, and is visible in the next layer, including the coating layer
<b>retooling</b>	Rework of partially set mortar joints (see tooling)
<b>sealant</b>	A permanently flexible compound, applied in plastic form between adjacent building components or materials to fill gaps or joints, usually to provide a waterproof seal
<b>set</b>	The process of changing from a liquid to a solid by a chemical reaction, as occurs with adhesives, plastics, paint, concrete or plaster
<b>sheet system</b>	A product produced in rolls or folded sheets of flexible material
<b>single skin</b>	A continuous vertical tier of concrete masonry one unit in width
<b>soaker</b>	Flashing behind mitred angles of aluminium joinery
<b>solid-filled</b>	All blockwork cells, irrespective of whether they contain steel reinforcement or not, are filled with grout
<b>solvent</b>	Liquid used in paint manufacture to dissolve or disperse the film-forming constituents, and which evaporates during the drying process
<b>spalling</b>	The breaking away at the edges of masonry materials and concrete through weathering, chemical action (including pressure produced by the corrosion of reinforcing) or excess loading
<b>specific design</b>	Specific engineering design – the design requires engineer's calculations and design input (outside the scope of non-specific design standards)
<b>spread</b>	The extent mortar or grout flows outward when a certain amount is placed on a horizontal surface – indicating whether the proportions are correct
<b>strapping</b>	Timber members (on DPC) fixed to concrete masonry to which wall lining is attached
<b>substrate</b>	Building surface that receives waterproof finishes
<b>tanking</b>	A continuous waterproof membrane applied to a vertical basement wall to prevent the ingress of water

<b>tooling</b>	A process where the mortar is reconsolidated after the initial water loss (once the mortar is thumbnail hard) with a tool which is pushed along the mortar lines, giving a smooth, dense finish
<b>torch-on</b>	A process where a product is applied using heat to adhere it to its substrate
<b>trim cavity</b>	Cavity between the joinery unit and the rough opening
<b>unprotected ground</b>	Unpaved or natural ground
<b>veneer</b>	A single skin of non-loadbearing concrete masonry which is attached to and laterally supported by a structural wall of masonry or timber
<b>waterproof coating</b>	A coating/finish to resist the ingress of water
<b>weathertightness</b>	A state where water is prevented from gaining entry to the interior of a building through the building elements
<b>well-founded</b>	Where foundations are taken down to good bearing ground so the structure does not subside or settle
<b>z-flashing</b>	A horizontal flashing which is folded into a z profile

