DESIGN NOTE TB2 - MAY 2011

THINK BRICK NEW ZEALAND

KEY REQUIREMENTS FOR DESIGNING AND BUILDING USING CLAY BRICK VENEER

BASIC BRICK

Marketed by the NZ Clay Brick & Paver Manufacturer's Association

CONTENTS

PLEASE NOTE: At the time of publication the requirements for brick veneer construction as a cladding option are being transferred to Acceptable Solutions AS1/E2 which are yet to be finalised.

1.0 DESIGN FUNDAMENTALS

1.1 The Brick Cavity

It is rare to have any issues in regards to weathertightness in a brick veneer simply because it has always been constructed using a cavity between the bricks, and the timber framing that supports it. Correctly constructed, it is a very robust system.

The cavity performs 4 important functions. It separates the flexible timber structure from the rigid brick structure, allowing movement. It provides a method of securing the brick cladding to the structure. It provides a means of allowing air movement to dry the brick veneer, but without question, it's most important function being to prevent moisture from the bricks transferring to the timber framing.

The minimum width cavity is 40mm and the maximum 75mm – this measurement is taken from where the brick tie is secured to the framing, which is not necessarily the line of the supporting structure. If for any reason the cavity is less than the 40mm minimum, such as a particular brick detail, it is essential that the timber framing is protected using a water-proof membrane such as polyethylene.

Specifying and installing 'wash-outs' at the base of the brick veneer is standard 'Good trade practice'. This involves laying every 10th brick plus a corner brick on a bed of sand, once the veneer is approximately 800mm high, remove these bricks to facilitate the regular washing out of mortar at the base of the cavity. A clean cavity, one free of mortar bridging the gap, is essential to preventing moisture transference.

The cavity width should be clearly marked on all working drawings. Recommendation: Design to a 50mm cavity. It provides a 10mm tolerance for variations in the framing, slab, and accommodates plywood bracing should this be a requirement.

Mortar should not encroach into the cavity more than 5mm.

1.2 Vent and Weep Holes

It is important to remember that brick veneer is not waterproof; however, clay brick veneers are an excellent rain shield. A saturated brick veneer weighs approximately 8% more than a dry veneer, reflecting the density of the product. In a clay veneer, a considerable amount of water is required before moisture is likely to flow down the back of the veneer.

The requirement for weep holes along the bottom of a clay brick veneer is one 75 x 10mm weep hole every 800mm along the base or alternatively 1000 sqmm's/m of wall. Any weep hole wider than 13mm requires vermin proofing.

The weep hole requirement also applies across the heads of doors, windows and openings.

Brick veneer also requires ventilation at the top of the veneer to ensure good air circulation, allowing air to move through the weep holes at the base, up the cavity and out through the top of the veneer. The requirement is the same as for the base. However, if a 10mm gap is left around the top of the veneer, no vertical vent holes in the perpend joints are required. Note, always install the vent holes in the second brick from the top so as not to weaken the bond of the bricks on the top row. Refer Fig. 12.

Vent holes are generally not required under window sills as air can move freely around the frame. However, common sense should apply for windows over 2.4m in length, install one or two vent holes evenly spaced under the sill.

Where a brick veneer is to be plastered and painted, the brick veneer exterior cladding is effectively a waterproof system and therefore the need to have air circulation to dry the cavity and the veneer, plus weep holes to drain the veneer, is considerably less important. The accepted approach to weep holes in this scenario is 50 x 10mm weep holes at 1.0m crs or 500 sqmm's/m length of wall. There is no real need to install vent holes along the top of the plastered veneer, check with your local council as they do have varying opinions.

1.3 Brick Ties

The brick veneer itself carries a durability requirement of 15 years as a cladding. However, the brick ties that secure the bricks to the structural framing are considered a structural element, and have a 50 year durability requirement.

It is important to check the site location of the brick veneer installation. If it is within 500m of the high water mark or within 100m of a tidal estuary, stainless steel brick ties will be required. If you are unsure, ask your local council before commencing work.

All brick ties are screw-fixed using a 35mm x 12g screw.There are 4 standard brick tie lengths available, 85mm, 105mm, 115mm and 135mm.The length of the brick tie to be used in a particular situation, is dependent on two factors; the width of the brick cavity, and the width of the brick being laid.The measurement from the middle of the brick to the point the tie is to be attached to the framing, governs the minimum length of tie.The tie must be at least half way across the width of the brick, but also have a minimum cover of 15mm over the end of the tie.

The tie must be installed with a 5º slope down from the frame, and may be laid directly onto the clay brick in most cases.

The bottom brick tie must be within 400mm of the base of the veneer.The ties are to be fixed to studs only, at a maximum of 600mm crs horizontally, and 400mm maximum vertically.Ties should also be positioned within 200mm of openings.

1.4 Mortar Joints

Mortar joints make up between 16% and 20% of the face of the veneer, so they have a considerable impact on the look of the finished wall, and therefore should be given the attention they deserve.

The shape and finish of the joint, the colour of the mortar and the consistency of the joints, all play an important part in the finished appearance of the veneer.

Mortar joints should be 10mm +/-2mm; the minimum joint thickness is 7mm and the maximum 13mm.The bottom mortar joint may be up to 20mm in thickness to accommodate variations in the slab. These requirements apply regardless of the veneer being plastered.

The mortar joint may be raked to a depth of 6mm max. It is recommended that the rake be set at 4mm then tooled smooth in order that the 6mm is not exceeded. It should be remembered that modern bricks may only have an external wall thickness of 15mm.

All mortar joints must be fully bedded; perpend joints require special attention to ensure this happens.

1.5 Slab Recess

The cavity system employed in brick veneer construction is extremely robust, and an important part of this system is the recess in the floor slab in order that the brick veneer sits below the level of the finished floor.This allows any moisture reaching the inside face of the bricks to run down the wall and escape out a weep hole without posing any threat to the inside of the dwelling, and in particular the timber framing. Refer Fig. 6

The building codes require a minimum 50mm step down, however, it is strongly recommended that you design and build to a 90 – 100mm step down for added security. In addition, external sealed ground can then be taken to the base of the brick veneer virtually hiding any foundation.

It is 'Good trade practice' to put a sloping fillet at the base of the cavity to direct water to the outside, but this is not essential.

It is important to prevent any moisture sitting in the bottom of the cavity from penetrating through the edge of the slab, under the damp proof course of the bottom plate, and entering the dwelling.

The sealing of the slab edge and the bottom of the cavity (does not need to go under the brick) can be done in several different ways.The polythene under the slab can be extended into the cavity and taken up and stapled to the framing, with the building wrap brought down on top of it.Two coats of bitumen emulsion paint can be applied to the slab edge and the base of the cavity.The slab edge and the base of cavity could be sealed using a flexible flashing tape such as 'Aluband'.

The width of the recess at the base of the veneer upon which the bricks sit, is governed by 3 factors; the desired cavity width, the width of the brick to be used, and the amount, if any, that the brick overhangs the foundation. Often at the design stage the brick product to be used is yet to be decided so it is important to design a ledge width that provides the builder and homeowner with the most flexibility. Recommendation: Design using a 120mm wide ledge and planning to overhang the brick 10mm to provide a drip edge is 'Good trade practice'.

1.6 Control Joints

Generally there is no need for control joints in clay brick veneers, which are very stable. A fractional expansion can occur soon after manufacture but this does not present any issues in normal residential construction.

Other materials, such as concrete or natural stone, which can also be used in veneer construction can shrink in size to an extent that control joints are normally required.

It is not uncommon to read reports from Geo-Tech Engineers requiring control joints in clay brick veneers due expansive clay soils but this is not necessary. Where such soil types occur an appropriate foundation should be designed to manage this and there is no evidence that control joints would be necessary.

However, control joints should be considered in clay brick veneer in the following circumstances. If a wall is 10.0m or longer and has no window or door openings then a control joint should be installed at an intermediate point. Where a small panel of brickwork adjoins a large panel of brickwork movement within the framing may cause a crack and a control joint should be considered. Alternatively, strengthening the framing, using additional brick ties and particularly using Bricklock reinforcing in mortar joints in these areas may be sufficient.

It is important to remember that if a crack develops in an otherwise well-constructed brick veneer it is an aesthetic issue only and creates no problems as to weathertightness or the overall integrity of the veneer. A control joint is in effect a controlled crack.

Control joints can be formed as shown in Fig. 8. Alternatively, a straight saw cut will achieve the same outcome. If possible position control joints behind down pipes to hide them. Where a control joint is used it is important to ensure that the framing details provide a stud within 200mm of each side of the joint for the fitting of brick ties.

1.7 Flashings

The brick veneer system has functioned in New Zealand very successfully for many years with minimal flashings being installed; however, in the modern environment, flashings are an essential part of any cladding system.

The most important flashings are around openings such as doors and windows; the head flashing being the critical element. Refer Fig. 2 .

If a metal head flashing is used and fixed to the framing, ensure it is kept 5mm short at each end, and the ends of the flashing turned up. This will allow for any movement in the framing without interfering with the bricks. A 5 – 10mm gap between the underside of the lintel bar and the flashing allows for both drainage and ventilation eliminating the need for weep holes in the bricks across the head of the opening.

Jamb flashings are simple and inexpensive. Use a 200mm wide Supercourse 500 polyethylene flashing, tucked into the joinery flange. The open end of the flashing is to be held off the building wrap using a kick-out batten or protruding clouts. Refer Fig. 3. The junction between the bricks and the joinery does not need to be sealed.

The sill flashing is equally important; any moisture driven up the sill brick needs to be stopped from reaching the timber framing and directed into the bottom of the cavity as shown in Fig. 4. Extend flashings 200mm past the sides of any openings where practical to do so.

1.8 Veneer Heights

The maximum height for single storey veneers is 4.0m from the foundation. At the gable area you may go to a maximum of 5.5m to the apex. These requirements apply when the veneer is supported by a timber frame, as stipulated in NZS3604:1999

To build to heights that exceed the above limitations, obtain a copy of Design Note TB1 Two Storey Clay Brick Veneer Construction – Made Easy as marketed by the NZ Clay Brick & Paver Manufacturer's Association.

If the veneer is supported by a masonry structure, NZS4229 permits a veneer height of 6.0m for wall and up to 10.0m to the top of any gable.

Note: Some of these height requirements may be extended in any new codes or standards based on shake table testing BRANZ carried out in 2009.

2.0 BRICKLAYING REQUIREMENTS

2.1 General

It is important to remember that any issues regarding the quality, texture or colour of the bricks must be addressed with the brick supplier prior to the laying of the bricks. A brick laid is a brick accepted. Thoroughly check all pallets upon delivery.

Clay bricks marketed in New Zealand must meet the requirements of NZS4455, the manufacturing standard. This standard mainly refers to the size and compressive strength of the product. It does not mention, chipping, cracks, bowing or colour, all issues to do with whether a brick is considered a 'First Grade ' product or a 'Common'. This will vary depending on the texture and type of brick product, check with your brick supplier. Clay bricks are transported great distances and may be handled many times prior to delivery to site. Minor edge chipping in some bricks can occur, especially smooth faced bricks; this is to be expected and managed by the bricklayer in the laying process. Generally, a First Grade brick should have a face and one end free of surface defects; however the nature of the brick product being laid must always be a factor in this regard.

Brochures, websites, and display panels provide an indication of the brick product at the time they were created, which may be two years old. Clay bricks are a natural product that may change depending on where the clay is sourced and how it is fired at the time of manufacture – check with your brick supplier for recent product samples.

2.2 Blending

Brick is a finishing product and therefore it is essential that the bricklayer thoroughly blends the bricks in order that an even spread of colour is achieved over the face of the wall. Depending upon where the bricks were positioned in the kiln, will have a bearing on the colour of the brick, which is why it is important for the bricklayer to select bricks from at least 3 pallets to get as good a colour mix as he can. Step away from the wall and check regularly. Obvious pockets of colour on a brick wall are unacceptable and devalue the dwelling.

2.3 Keeping Bricks Dry

It is important to prevent bricks becoming saturated, particularly during the winter months. Saturated brickwork can aggravate any salts that may be present, resulting in white deposits on the surface, which can be long-term. Therefore, keep the top of all pallets covered with plastic, and where bricks may be stacked around the site, cover with plastic.

Freshly laid veneers, (less than 6 hours) must be protected from rain to prevent a possible change in the mortar colour. The top row of all unfinished brickwork must be covered in plastic, if rain is imminent.

2.4 Brick Bonding

New Zealand Standards require for running or stretcher bond, which means that the units of each course overlap the units of the preceding course by between 25% and 75% of the length of the units. If you wish to 'stack bond' it must to done to the specification detailed in TB2.

A 70mm brick may be laid to a third bond (metric bond) however, it is recommended that bricks always be laid to a half-bond in the traditional manner. This can be easily achieved by cutting all (70mm Series) corner bricks to 190mm in length.

2.5 Brick Sills

The slope and overhang of a brick sill is not important, provided they are consistent around the dwelling. It is traditional to overhang the sill 30 – 50mm with a slope of 10º - 15º. Bricks must be evenly spread and of equal thickness across the width of the sill. This applies to the heads of the windows as well. Refer Fig. 4.

2.6 Lintel Bars

There are two methods of installing 'Lintel Bars' – Traditional Refer Fig. 9, where the bar spans the brick from one side to the other, keep completely free of the structure and apply the angle sizes in the table below. The lintel bar should sit 20mm back from the face of the veneer, and have correct seating. The second method, Refer Fig. 10, is to attach the angle to the structure. In this case keep the angle 5mm short of the opening at each end. Check durability requirement.

LINTEL BARS SUPPORTING VENEER OVER OPENINGS

Max.Span (mm)	Size of Angle
3000 mm	80 x 80 x 6
3500 mm	100 x 100 x 6 or 125 x 75 x 6
4500 mm	125 x 75 x 8
4800 mm	125 x 75 x 10

2.7 Mortar

Good quality mortar ensures a veneer that will perform well not only throughout the life of the cladding, but in the event of an earthquake. Mixing mortar by volume is essential, 4 buckets of sand to 1 bucket of cement is the normal mix ratio. The volume of water, additives, and mixing time, all need to be consistent to achieve a quality mortar of an even colour.

It is very important that 'hydration' takes place. If the mortar shows signs of powdering, it is possible that 'hydration' has not occurred and the veneer may need to be pulled down. The most common cause of this is rapid loss of moisture when the bricks are first laid. If the temperature exceeds 27ºC, ensure the bricks are kept damp for the first 24 hours.

Discard mortar which is over an hour old and avoid re-tempering mortar with water. The correct time to tool a mortar joint is when a clear thumb print can be made on the surface.

2.8 Tolerances

ITEM	TOLERANCE
Deviation from vertical within a storey	10 mm per 3 m of height
Deviation from vertical in total height of bldg.	20 mm
Relative vertical displacement between masonry courses.	2 mm on nominated fair face (one side only) 5 mm on structural face
Deviation from line in plan: (a) In any length up to 10 m (b) In any length over 10 m	 5 mm 10 mm total
Average thickness of bed joint, cross joint or perpend joint.	+/- 3 mm on thickness specified

2.9 Cleaning

The brick veneer must be cleaned as the job progresses using clean sponges and clean water.

It is important to protect the brick veneer from becoming stained or marked, particularly by other trades during the construction period. Cover the brickwork around the water tap and ensure the hose is connected and away from the veneer.

Under no circumstances is the brickwork to be water-blasted using a high pressure system. If the bricks require a light acid wash, Corium 93 is specifically designed for this task; however, check with your brick company prior to applying any acid products to the bricks.

2.10 Flashings

It is the bricklayer's responsibility to ensure that all flashings have been correctly installed prior to the bricks being laid. Use kick-out battens to hold flexible flashings off the building wrap. Refer to the figures in this brochure for the correct installation requirements.

2.11 Inspections

In house construction it is normal for the brick veneer to be inspected by the council building inspector once the bricks reach half the height of the finished wall. The items being checked at this stage include how clean the cavity is, correct installation of the brick ties, cavity width, mortar quality, and joints, and the installation of flashings. It is the bricklayer's responsibility to ensure these inspections have been carried out and approved prior to continuing.

3.0 BRICK ISSUES

3.1 Using Hydrochloric Acid

Check with your brick supplier prior to using hydrochloric acid to clean their bricks. When using hydrochloric acid it is important to adhere to the following procedures.

- Thoroughly pre-wet the wall before applying the acid.
- Do not exceed a mix strength of 1 part acid to 10 parts water.
- Allow the acid solution 3 – 6 minutes to do the job required.
- Manage a maximum of approximately 5 sq.m at a time and wash down thoroughly on completion.

NOTE: Iron Oxide stains (rust) can be the result of using hydrochloric acid on clay bricks. This may be removed by applying a solution of 1 part phosphoric acid to 4 parts water; allow up to 24 hours to work.

3.2 Vanadium Stains

Vanadium is a naturally occurring salt in many clays that may appear on the finished brick product, normally within the first 6 weeks of the bricks being laid. The stain is quite vivid and comes in many colours from dark green, lime green, yellow, and reddish-brown; more obvious on light coloured bricks.

It will wash off over time, but an application of 4% Sodium Hypochlorite (Janola) or alternatively, a solution of Sodium Bicarbonate, 60gms/litre of water; applied on the stains will assist in their removal.

3.3 Efflorescence

The deposit of white salts on the surface of brickwork is common, and referred to as 'efflorescence'.

For efflorescence to occur, three conditions must exist. There must be salts present. There must be water entering the masonry, and the masonry must be able to dry out.

The white salts must first be brushed off the surface using a stiff dry brush and the deposits collected where possible. The wall can then be wiped over with a damp cloth to remove some of the remaining deposits. This process may need repeating several times until all salts have been removed from the bricks. Do not hose off. Good laying practices help prevent efflorescence occurring.

3.4 Manganese Stains

This stain occurs characteristically along the edges of grey or brown bricks that have been produced using manganese to achieve the colour. It appears as a dark-blue brown discolouration

If you suspect that manganese staining has occurred, contact your brick company for them to inspect and advise on a resolution.

3.5 Copper and Bronze Stains

Often brick veneer has cap flashings or is in close proximity to metals such as copper or bronze. Water washing over these metal surfaces can result in a bluish-green stain appearing on the surface of the bricks. These stains may be removed using a solution of 1 part of volume of acetic acid (80% or stronger); 1 part hydrogen peroxide (30% - 35% strength); 6 parts water.

3.6 Smoke Stains

Common around domestic fireplaces but can also be an issue with fire damaged buildings. Minor stains can be removed readily with sugar of soap, which is highly alkaline mixture. Mix approximately 500 gms into 2 litres of hot water and apply liberally by brush. After the stains disappear scrub with a mixture of detergent and household scouring powder containing sodium hypochlorite (Janola).

3.7 Graffiti

These are difficult stains to remove, particularly if they have aged. In the case of fresh aerosol paint a proprietary paint remover can be used, and a water rinsible type is recommended. Commercial paint removers, applicable to a particular type of paint, can be used satisfactorily.

To remove dried paint, the stained area is flooded for a few minutes with a paint remover of the methylene dichloride type, scrubbed to loosen the paint film and then flushed with water to wash away the loosened paint. Final scrubbing is done with a scouring powder until the stain is removed.

For specialist advise or assistance contact a commercial company such as Graffiti Solutions Ltd, www.graffitisolutions.co.nz

3.8 Water-proofing Veneers

Clay brick veneers correctly installed do not need to be waterproofed as they manage water very well. However, situations do arise where water-proofing the brick veneer is a good solution to what may be a difficult problem.

New nanotechnology, water-based water proofing products are now available.They are safe to use and have little effect on the appearance of the finished brick veneer, contact your brick supplier.

4.0 STACK-BONDING OF BRICKS

The 'Stack bonding' of clay brick veneers, provides the architect/designer with the ability to create a brick cladding that presents both vertical and horizontal lines and patterns that add new dimensions to the architectural appeal of a structure.

This type of bonding is not permitted under NZS3604 and NZS4229, but it is permitted under NZS4230 using specific engineering design.The CB&PMA engaged BRANZ's structural engineers to provide a methodology by which stack bonding would be acceptable based on their historic testing and engineering considerations. BRANZ have provided the following specification and limitations for its use.

- Studs are to be positioned at a maximum 400mm centres.
- Screw fixed brick ties are to be installed at maximum 400mm centres horizontally and 400mm centres vertically (every 4th course commencing at two courses above the base or equivalent in the case of a double height brick).
- 'Bricklock' joint reinforcement, manufactured by Eagle Wire Products Ltd, is to be installed every 4th course (or maximum of 400mm) alternating with the rows of brick ties.
- The maximum permitted height is 4.0 m unless Specific Engineering Design has been undertaken to cover the additional required height specified.

5.0 BRICKS WALLS

Fundamental rules for brick walls.

- Avoid filling columns with reinforced concrete. Always support fences and brick columns using timber or galvanised metal posts upon which the bricks can be tied.
- The foundation needs to be 150 – 200mm deep and a minimum of 50mm wider on each side of the brick line. It should contain a minimum of 2/D12 rods. Check for tree roots and either remove or bridge the roots using a flat galvanised steel plate.
- On a single skinned wall, keep the columns approximately 2.0m apart and the H4 posts at least 800mm into the ground.
- Use Bricklock STR joint reinforcement every 4th course extending it through and tying it to the posts.
- On columns, use Bricklock CNR every 4th course through the height of the column.Tie the bricks in the column to the post, also every 4th course opposite each other, alternating around the column.
- Double skinned walls need to be tied together using rectangular box ties every 4th course at 600mm crs. Incorporate 100 x 75 H4 posts and rails in the cavity to also tie the bricks.
- Check with your council on height limits and building consents.

FIG.1 SOFFIT DETAIL

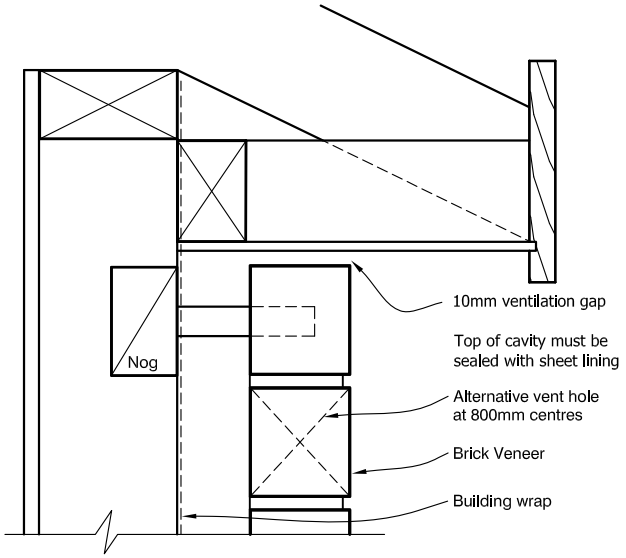


FIG.2 WINDOW HEAD - Aluminium

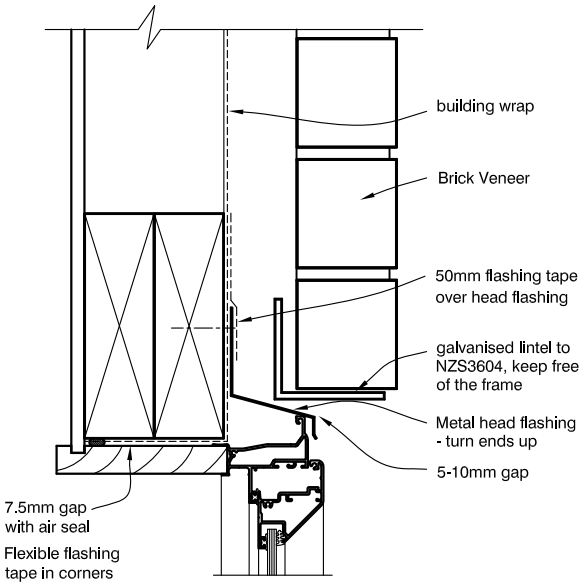


FIG.3 WINDOW JAMB - Aluminium

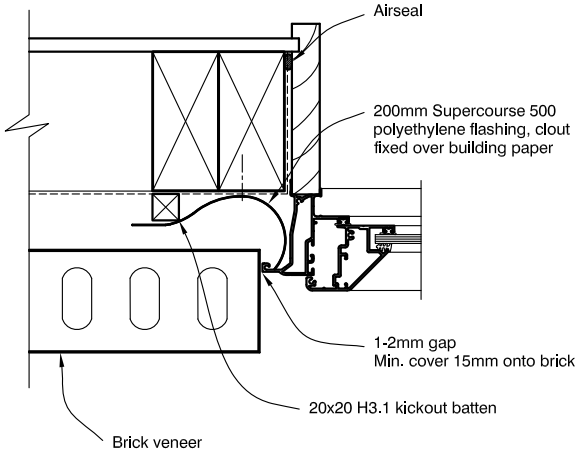
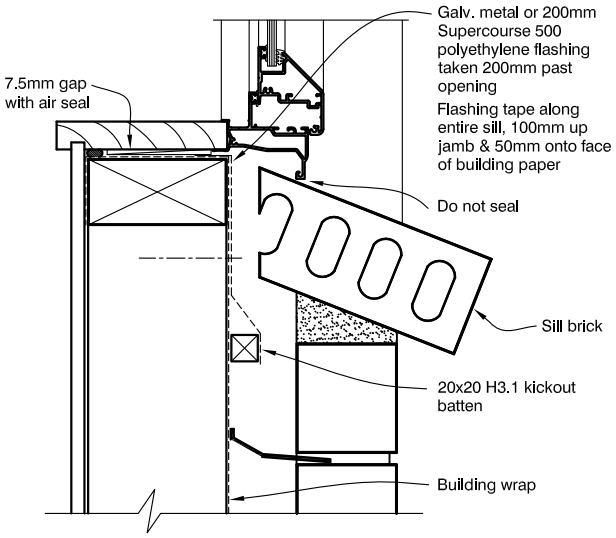
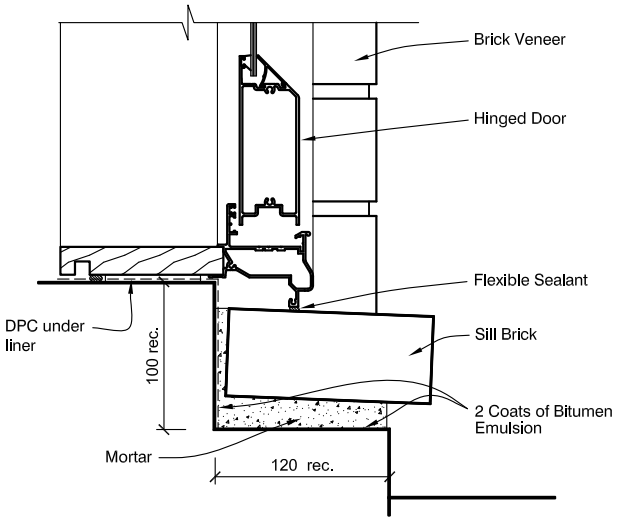


FIG.4 WINDOW SILL - Aluminium



WANZ 55mm aluminium support bar ommitted for clarity. Refer www.wanz.co.nz

FIG.5 DOOR SILL - Aluminium



Note: If sill brick is to be sloped further if necessary either increase the depth of the step or reduce the thickness of the brick. Coat with a water repellent sealer.

FIG.6 CONCRETE SLAB & FOUNDATION

Min. Required for 1 & 2 Storey

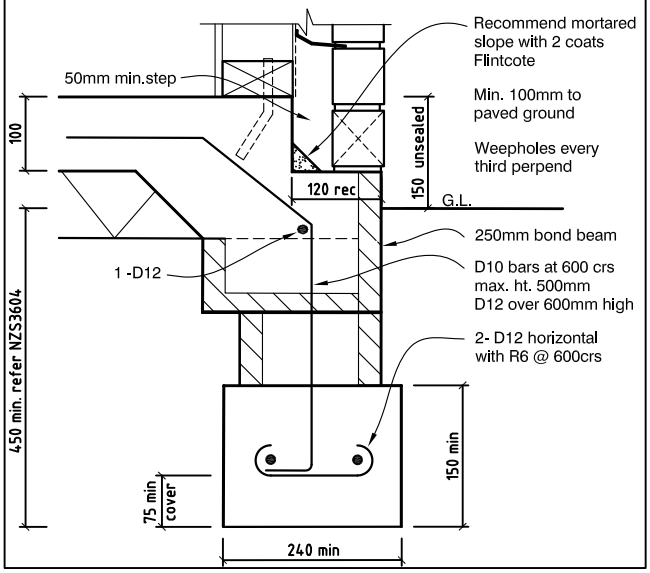


FIG.7 INTERNAL CORNER

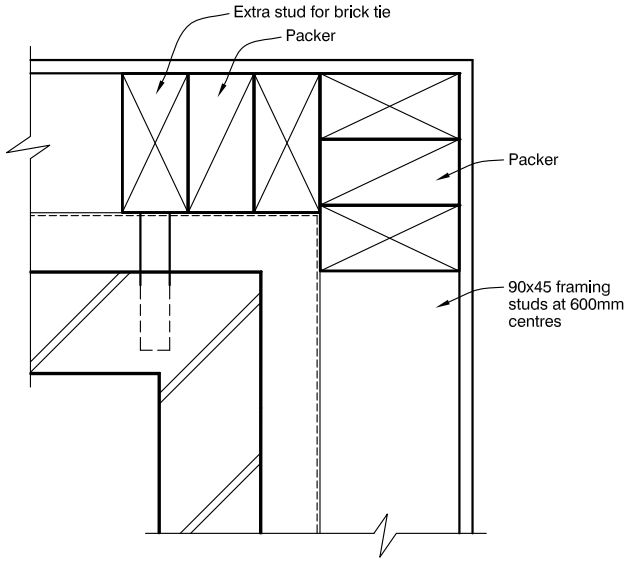


FIG.8 CONTROL JOINTS

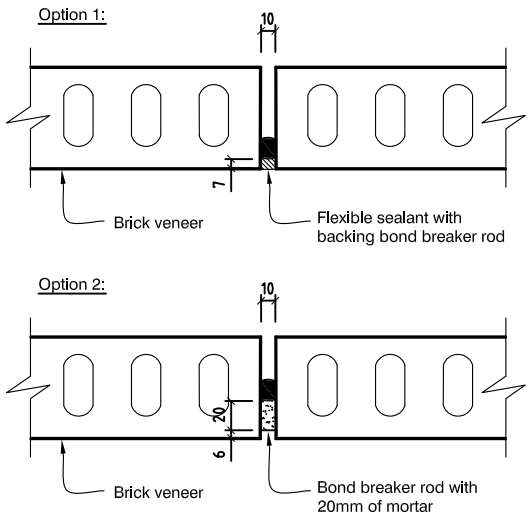


FIG.9 LINTEL BAR - TRADITIONAL

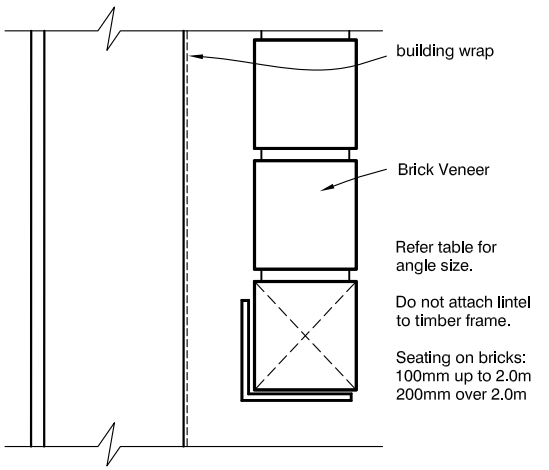


FIG.10 LINTEL BAR - FIXED TO FRAME

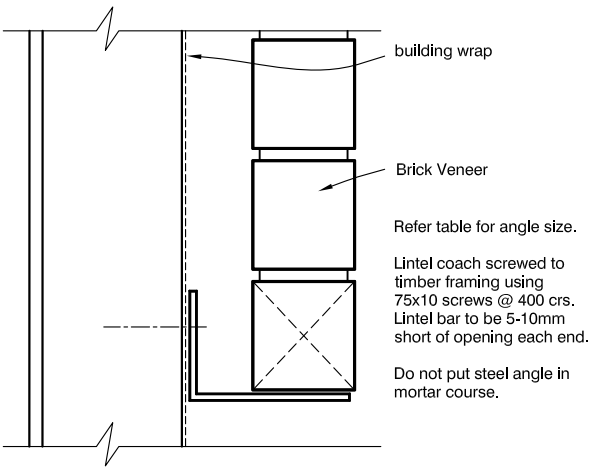


FIG.11 METER BOX

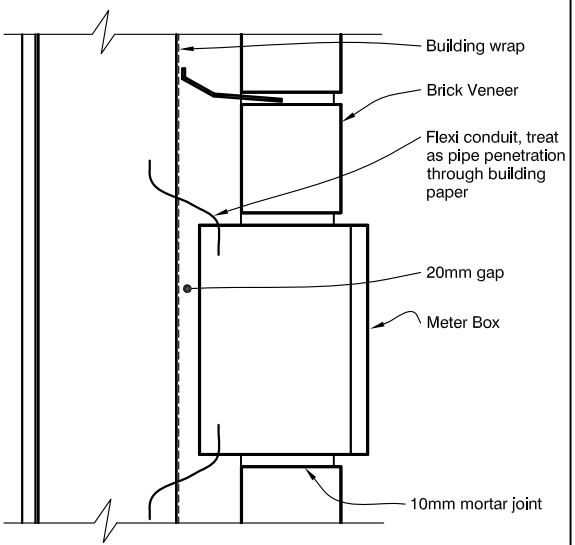
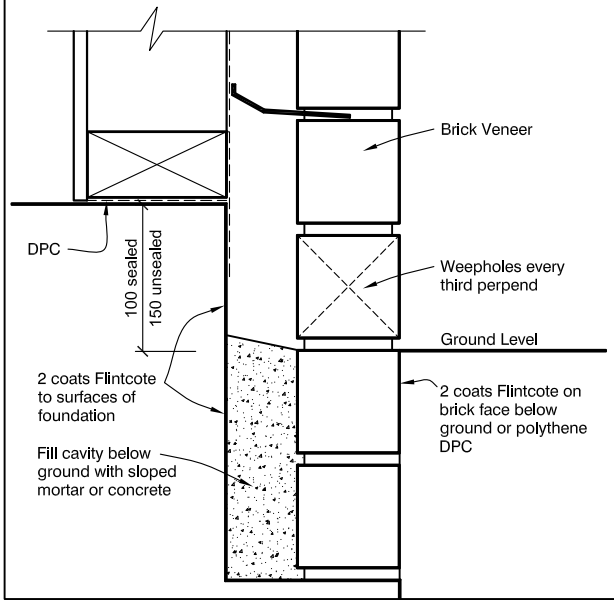


FIG.12 BRICK VENEER BELOW GROUND



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