5.1 Veneer Walls

General

NOTE: ***This section has been revised to meet the provisions of E2/AS1 and E2/AS3.***

Cavity wall construction has been recognised as an excellent means of offering the greatest weather resistance.

The inner skin of such construction traditionally has been considered the structural member and therefore designed to carry all horizontal, vertical and seismic loads. In residential construction in New Zealand the timber frame has been fulfilling a structural role and arising from this, there has developed the veneer concept of the outer skin of masonry and an inner timber frame.

The principal advantage of using such construction is the excellent weather resistant construction not incurring any significant maintenance costs.

While traditionally the cavity width has been maintained at a minimum of 40 mm, new technology involving the use of a water resistant inner lining has resulted in the development of alternative systems.

A range of typical veneer construction is shown in Figure 1 (page 2).

An alternative form has been the use of two veneer skins to create a permanent formwork system. The structure of the system is provided by a reinforced grouted core.

Codes

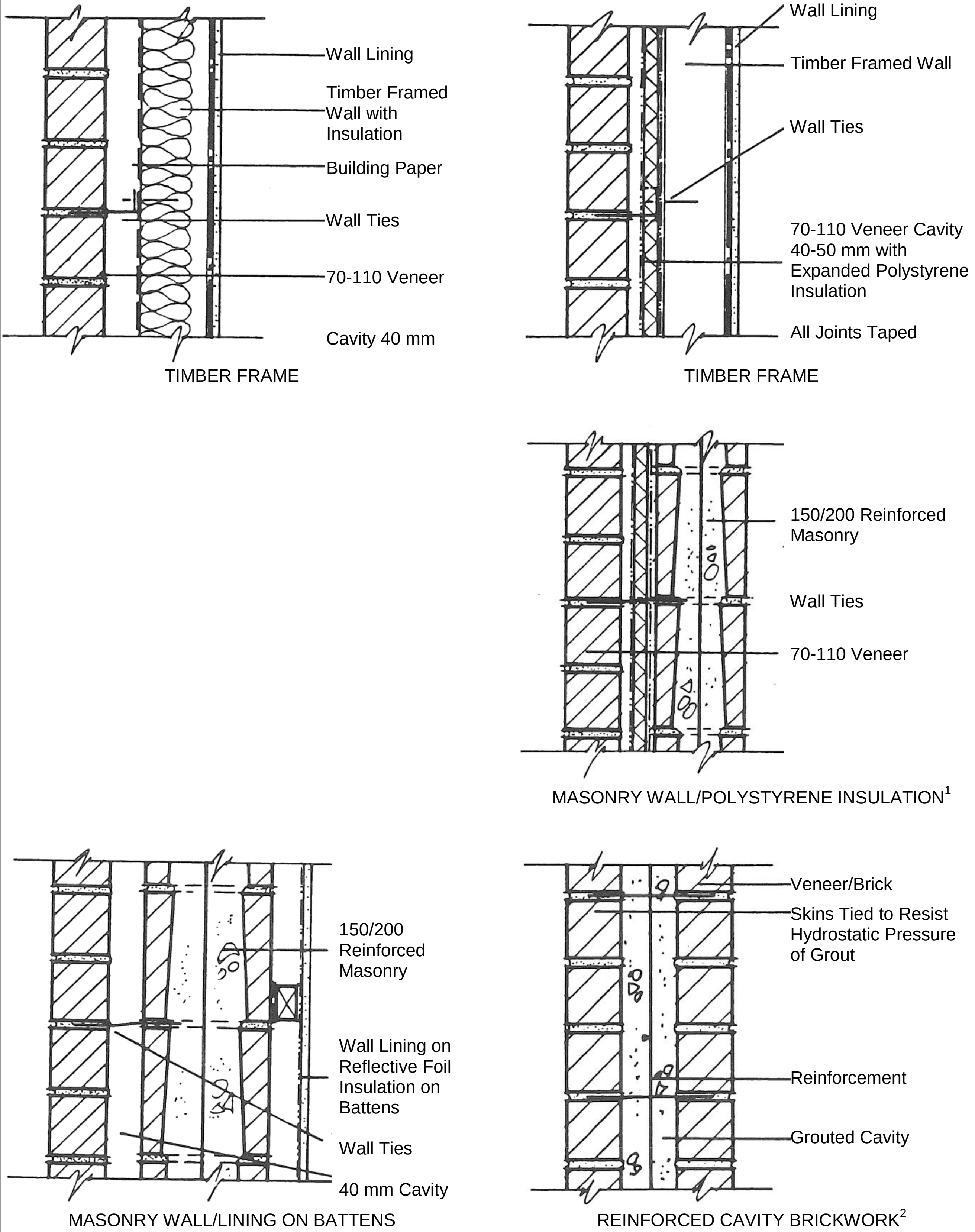
Concrete Masonry Wall Veneers are the subject of not one but several New Zealand Standards, mainly:

- AS/NZS 4455.1 *Masonry units, pavers, flags and segmental retaining wall units - Masonry units*
- NZS 4210 *Masonry construction: Materials and workmanship*
- NZS 4229 *Concrete masonry buildings not requiring specific engineering design*
- NZS 4230 *Design of reinforced concrete masonry structures*
- NZS 3604 *Timber framed buildings*
- New Zealand Building Code: E2/AS1 and E2/AS3

The principal code for veneer materials and workmanship is NZS 4210.





[1] Where a cavity is less than 40 mm, the construction becomes Specific Engineering Design.
[2] This construction is Specific Engineering Design.

Figure 1: Veneer Walls – Range of Typical Veneer Construction

Reinforced Veneers

Reinforced veneers are covered by NZS 4230 requiring walls to comply with Section 7 of that Standard in relation to thickness.

Unreinforced Veneers

Unreinforced veneers tied to walls of structures built within the provisions of NZS 4229 or NZS 3604 are limited in height.

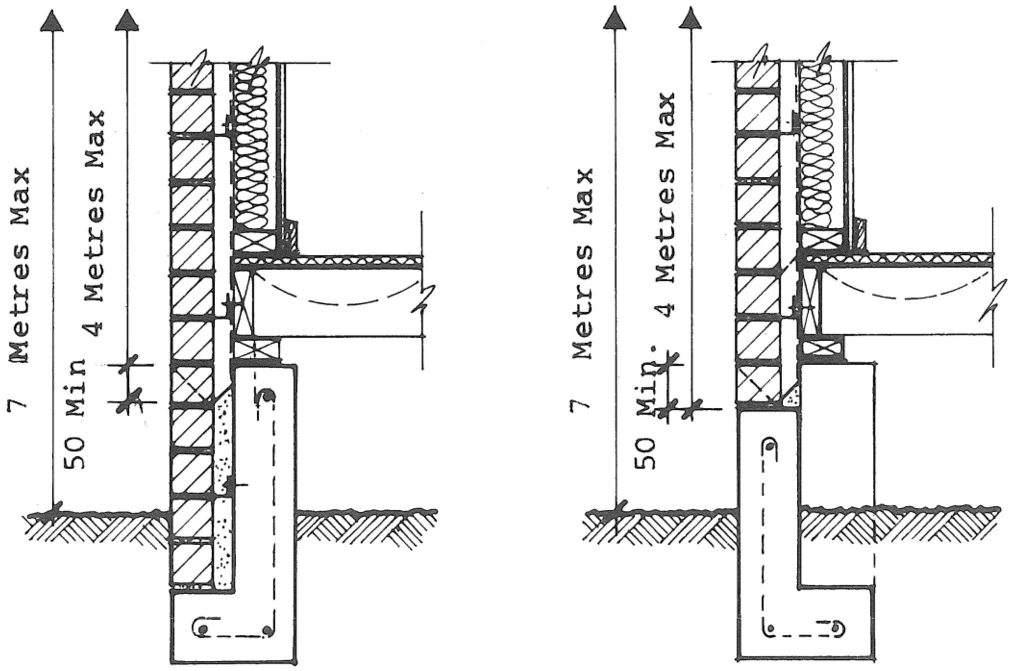
The principal details of the Standards are illustrated in Figures 2 and 3.

Figure 2 details the particular aspect of the measurement of the height of veneer walls from the top of the supporting foundation.

Figure 3 (page 4) deals with Non Specific Design Construction, (i.e. NZS 4229 and NZS 3604).

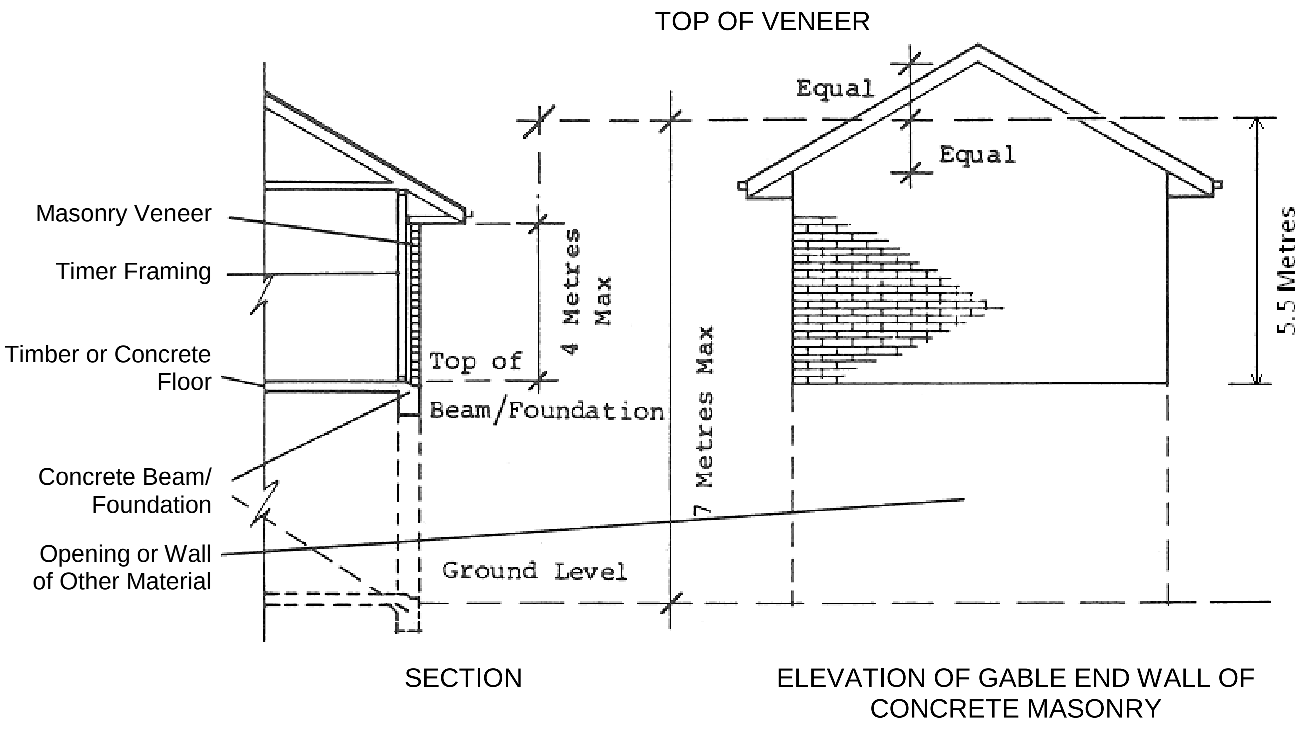
Note that Specific Design allows greater wall heights.

TO TOP OF THE VENEER*

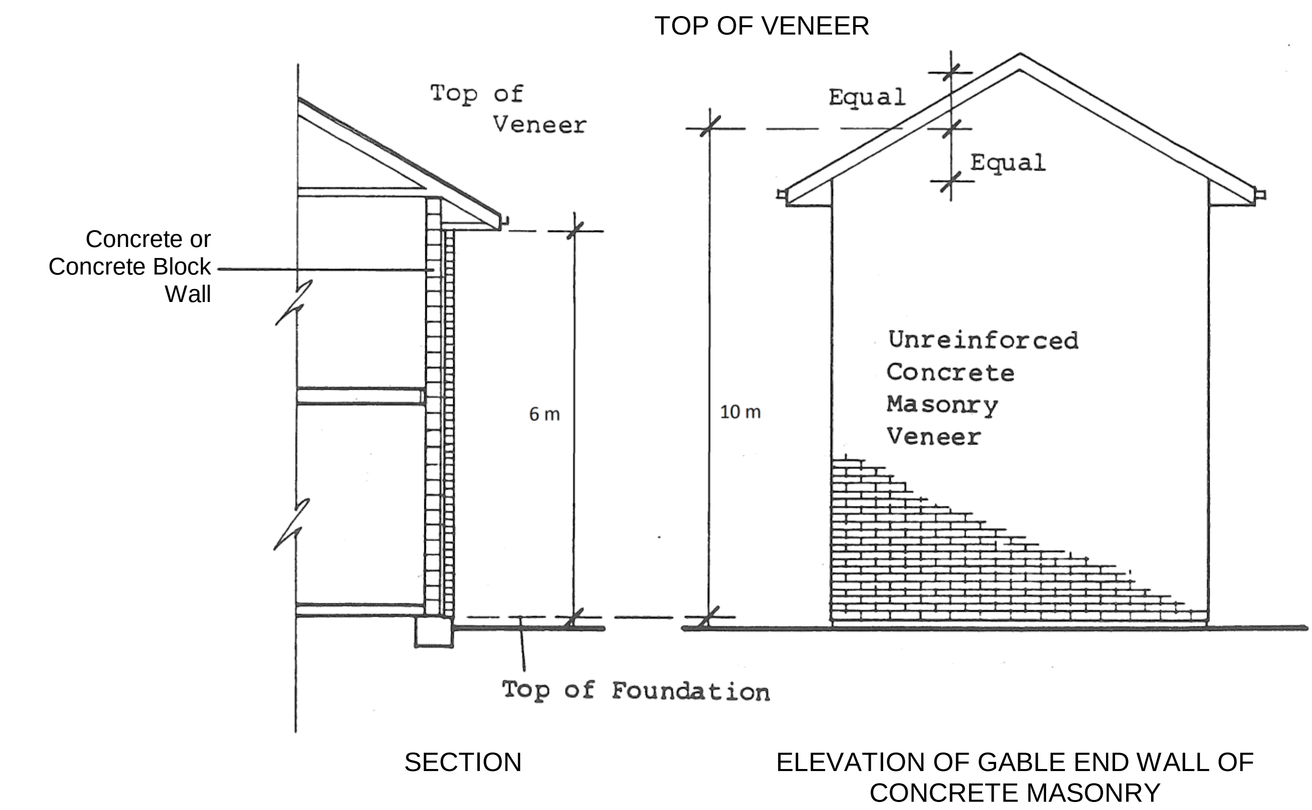


** The maximum veneer height is 5.5 m on a gable end wall*

Figure 2: Determination of Veneer Heights



Diagrams illustrating maximum height of unreinforced masonry veneer attached to timber framed wall as permitted by NZS 3604.



Diagrams illustrate maximum height of unreinforced masonry veneer attached to structural masonry or reinforced concrete wall as permitted by NZS 4229. If the gable wall adjoined on egress way than the height was restricted to 6 m.

Figure 3: Buildings NOT requiring specific design

Veneer Construction

Veneer Thickness

Minimum thickness of veneer is 70 mm. This follows changes introduced by the clay brick industry.

Maximum mass of veneer is 220 kg/m^3.

The New Zealand Concrete Masonry Association members confirm that the manufacturing standard for their veneer/bricks follow AS/NZS 4455.1. The normal bonding pattern lies between one quarter to one half.

The minimum length of a veneer return is 230 mm.

Cavity

The maximum width is 75 mm and the minimum width is 40 mm unless there is included some additional waterproofing.

Drainage must be provided at the base of each cavity. This is done most usually by providing weep holes through the lowest vertical joint. Typical details, such as F4, are shown in the Construction Section (3.3).

The detail indicates that weep holes are provided at 800 mm centres and that a step of 50 mm minimum is required from the underside of the veneer to the level of the inside slab.

A cement mortar flaunching or fillet is often used to direct cavity moisture to the outside.

While in some cases moisture from the cavity can be dissipated into the sub floor space, it is recommended that sub floor ventilation is not directly connected into the wall cavity.

Moisture Control

An overriding advantage of veneer walls is that any moisture penetration is halted by the cavity. Excess moisture must be drained away as described above.

Care must be exercised not to introduce moist air into the cavity and certainly not discharge air from the cavity into the roof space.

Air from the underfloor space of a timber floor should not be allowed to enter the cavity. The head of each cavity should be sealed and ventilating holes provided through the top veneer vertical joints. Adequate ventilation of the cavity can reduce possible surface efflorescence problems.

Under no circumstances should a drying cabinet, shower room ventilation or cooker vents be discharged into the cavity.

Wall Ties

The ties should be non-corrodible as defined in AS/NZS 2699.1:2000 Built-in components for masonry construction - Wall ties and NZS 4210, and embedded at least 50% of the veneer thickness. The cover to the outside edge of the tie should not be less than:

- 25 mm galvanised ties
- 15 mm stainless steel ties
- 10 mm plastic ties.

Ties are classified as Light, Medium and Heavy duty stiff ties and flexible ties. The latter are only used in specific design circumstances and require special joint details similar to that described on page 10, to allow the structural frame to move relative to the veneer.

Ties shall comply with the durability of Table 1:

Table 1: Table E1 - Protection for masonry veneer ties supporting masonry veneer using AS/NZS 2699.1 (see E5.2).

Location (NZS 3604 Exposure Zones)	Grades 316, 316L or 304 stainless steel	470 g/m^2 galvanising on mild steel
Zone B	Yes	Yes
Zone C	Yes	Yes
Zone D	Yes	No

Design performance criteria are available from the manufacturers of the special flexible ties, which includes various sliding joint details for window and door frames.

The conventional EM tie has maximum spacing limits as shown in Figure 4. EM ties can be used for veneer not exceeding 220 kg/m^2 in earthquake Zones 1 and 2 and 180 kg/m^2 in Zone 3.

Maximum Spacing

H x V	Timber Stud:	600 x 350 mm 450 x 450 mm
H x V	Concrete/Masonry:	600 x 400 mm

More details on earthquake zoning and spacing of ties is given in Section 5.2.

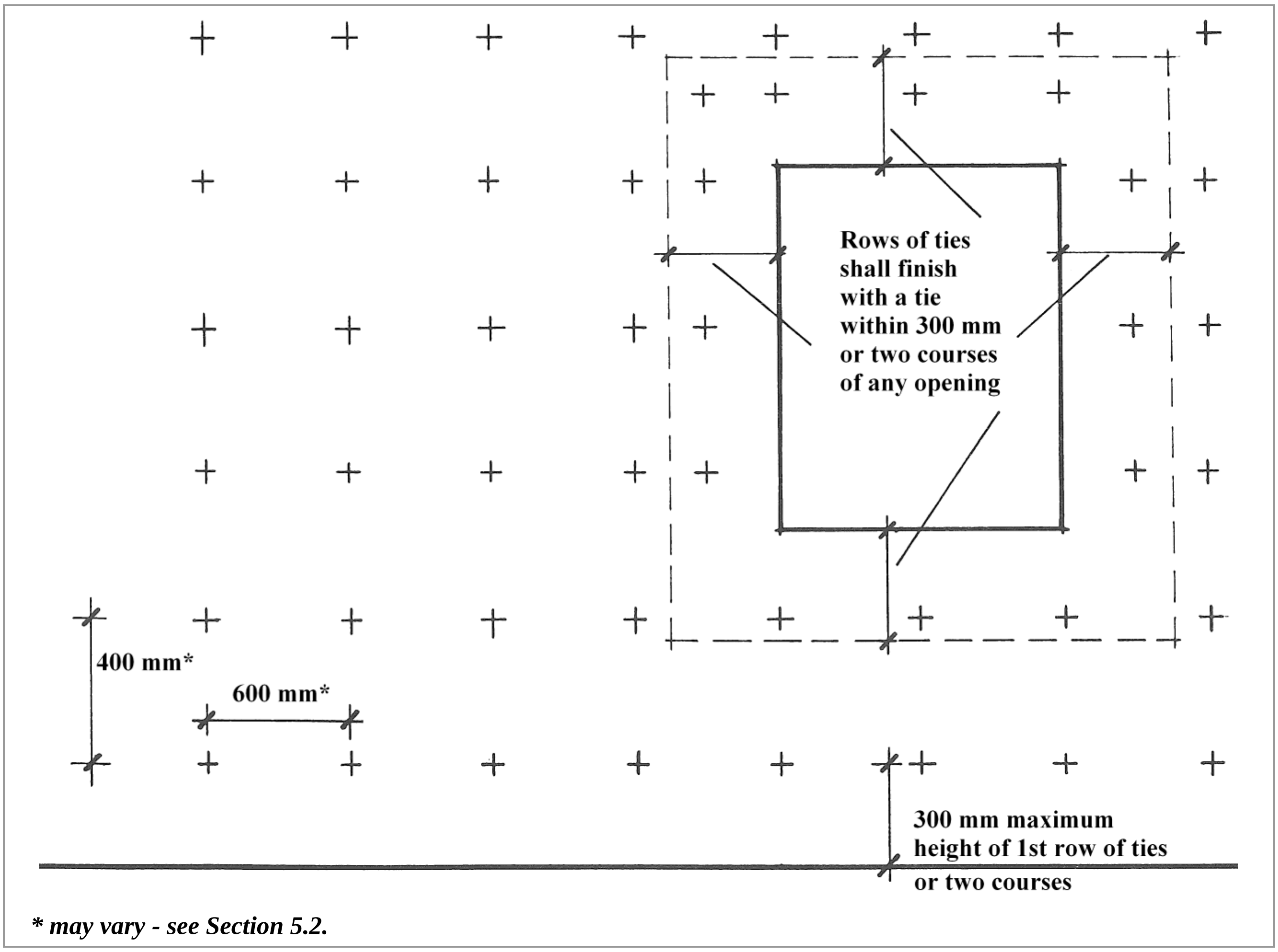


Figure 4: Spacing of Wall Ties

The current NZS 4210 and E2 AS1 require ties to be bedded within the mortar joint. However, the industry has been 'dry bedding' ties for many years. The practice has been structurally checked by BRANZ and found to be satisfactory. It is now accepted in NZS 4229 Appendix E 2013.

Where the veneer sits on a supporting or damp proof metal flashing, ties need to be placed in the next two courses above this position (see Figure 5). Where the veneer sits on a bitumen painted concrete surface at ground level, only one row of ties is needed in the first available course.

Control Joints

Concrete masonry veneer blocks, like other solid building materials, are subject to expansion and contraction from various causes including:

(i) Moisture change (principal factor)
(ii) Temperature change
(iii) Movement of other structural elements

In a long veneer wall the expansion/contraction may cause cracks to appear. Although such cracks may not be serious from a structural point of view, they can be unsightly.

Various rules for locating control joints have been developed from experience, and will probably continue to be refined.

Since there are many possible layouts of walls with their openings for windows, etc., some judgement must be used by the designer in determining the location of these joints.

Control joints are continuous, vertical joints built into the veneer, to relieve stresses which may occur. The most common requirement is for shrinkage control joints.

The predominant movement of a concrete masonry veneer is shrinkage which is a characteristic different to clay brick veneer where expansion is likely.

In long walls (unbroken by window openings, etc.) joints are usually spaced to produce panels having lengths of approximately 1½ to 2 times their height, i.e. 5 to 6 metres.

When there is a bonded corner (return end) then one side of the panel can be regarded as fixed. In this case the panel length should be reduced (Figure 6).

Window and door openings up to 1.8 m width require a vertical control joint inline with only one jamb (Figure 7), but wider openings should have joints at both sides (Figure 8).

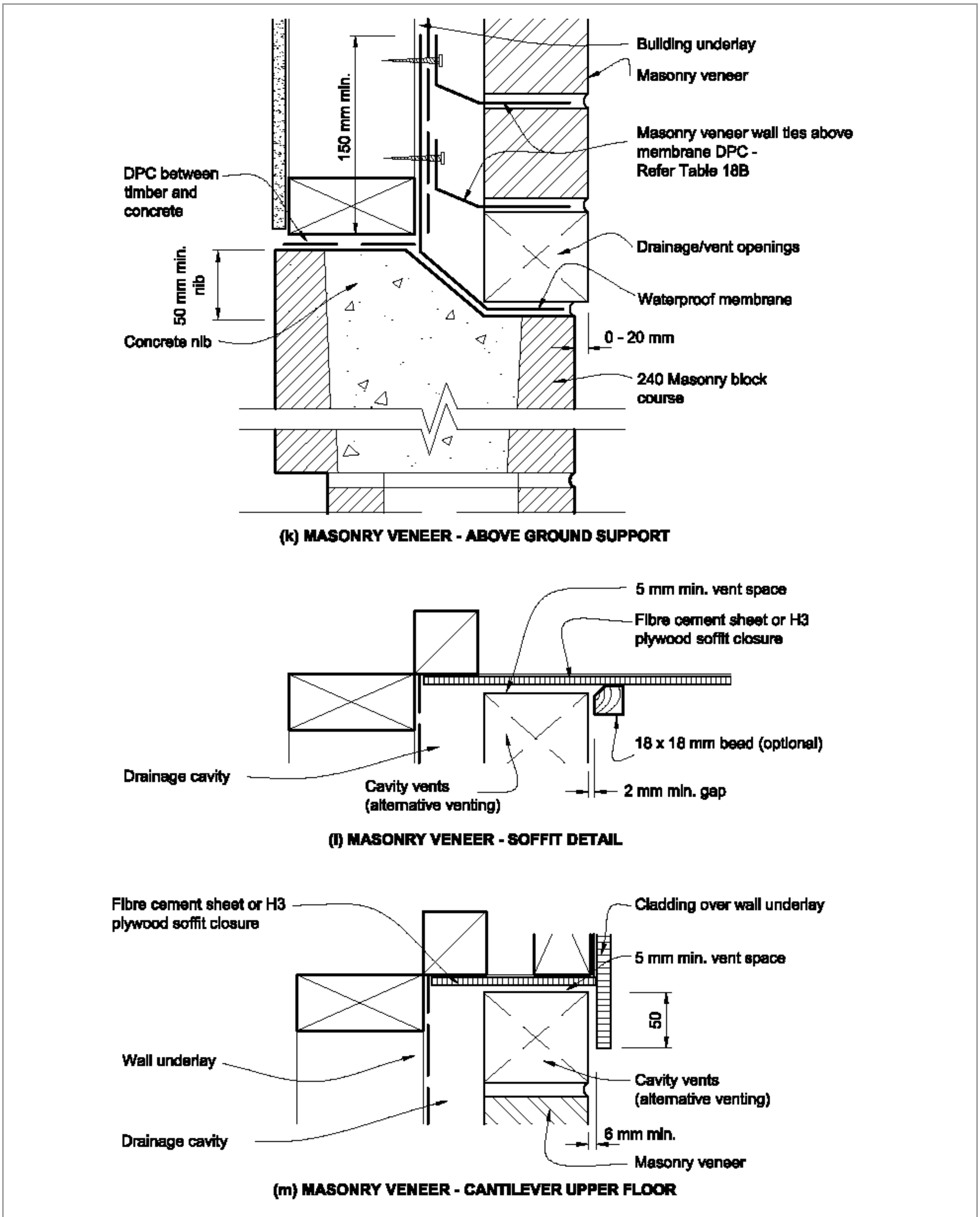
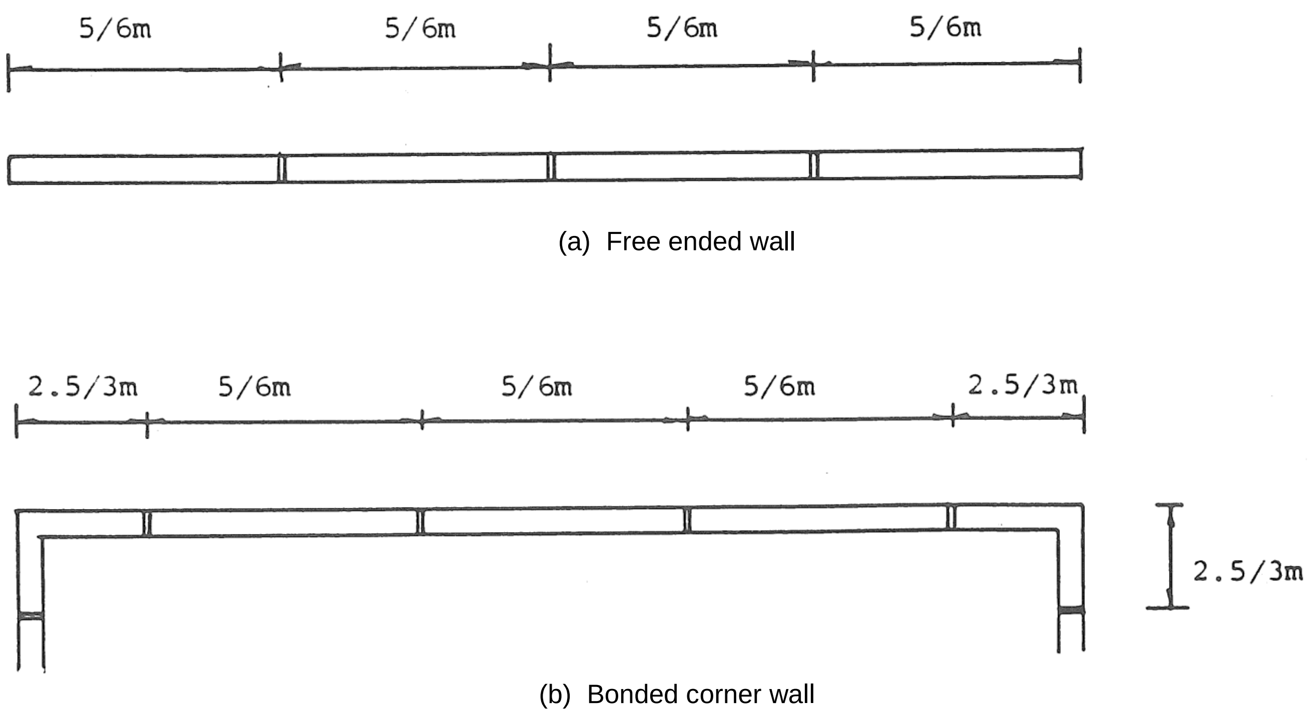


Figure 5: Veneer support, first floor level (Figure 73E, DBH E2 AS1 document)



Note: Windows/doorways will influence final exact position of joint.

Figure 6: Overall Positions of Shrinkage Control Joints

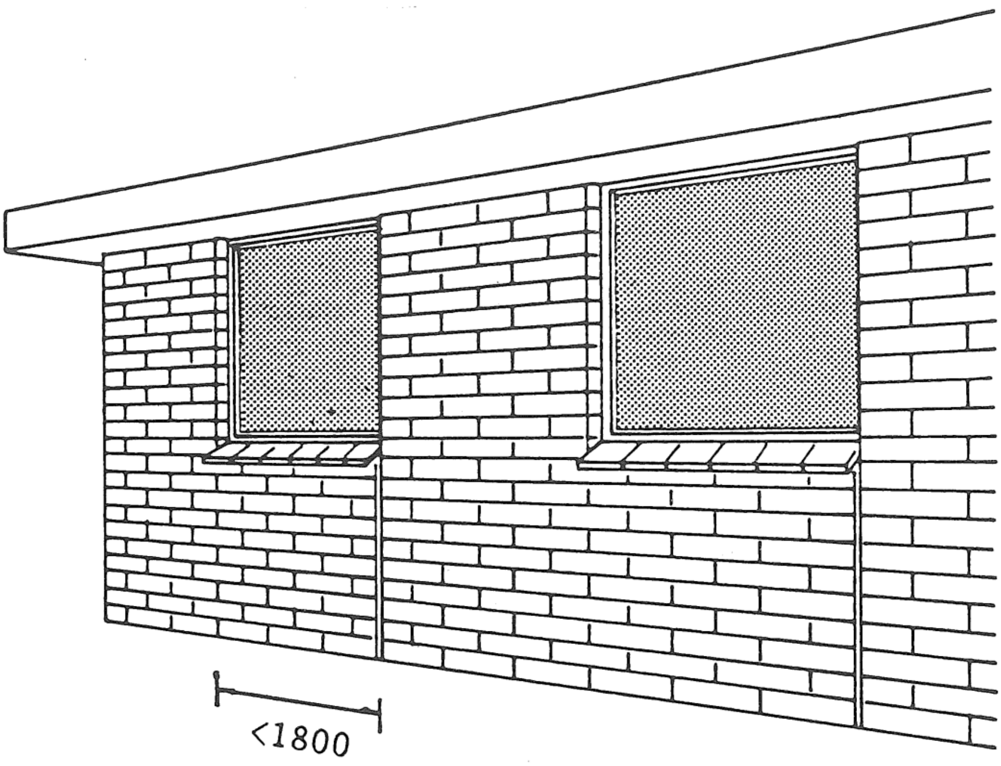
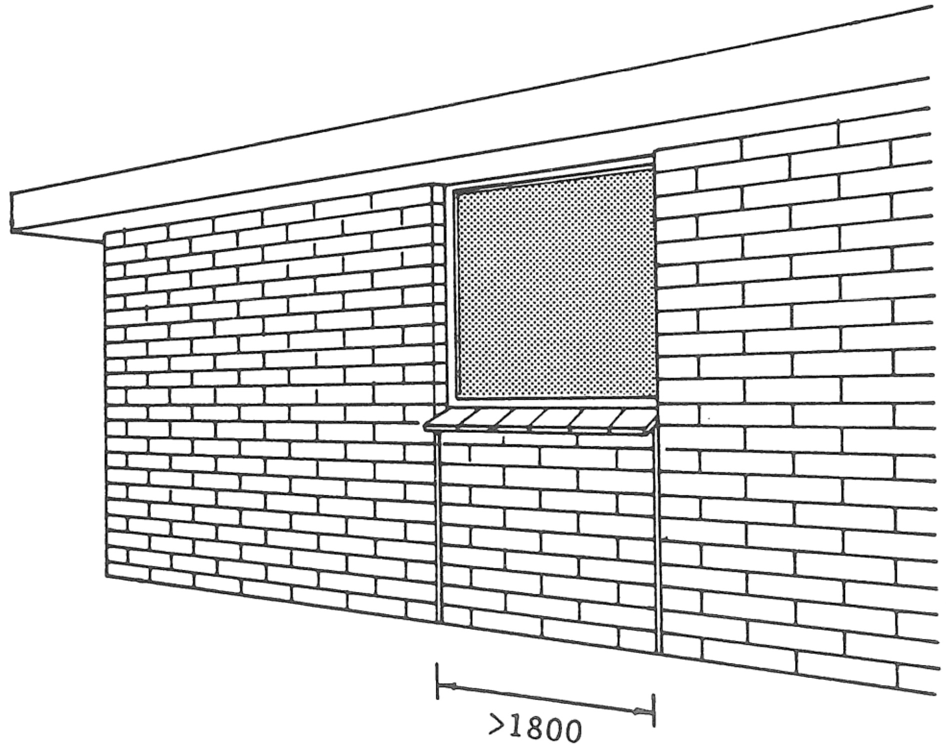


Figure 7



This panel can often be recessed or projected for effort.

Figure 8

A control joint between two closely situated windows should be avoided (Figure 9) because this would create two relatively narrow panels that would not allow the joint to function properly. Zigzag cracking would be likely to occur at the sills of the openings.

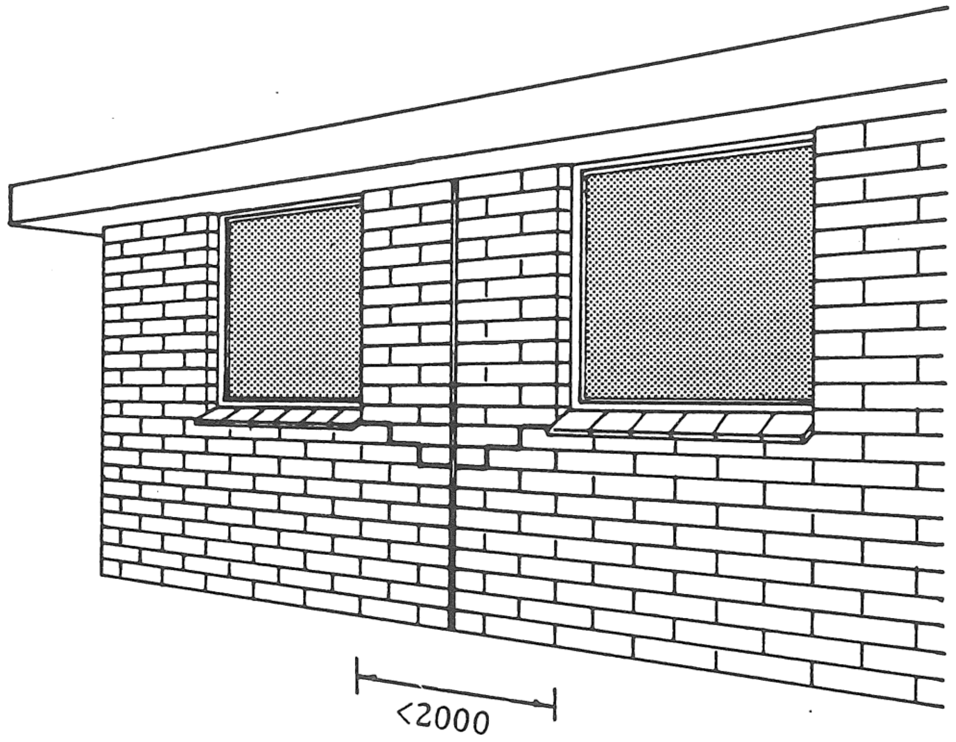


Figure 9

An alternative to control joints under windows is joint reinforcement as described in the next paragraph.

It should be noted that often jointing above door or window openings in veneers does not occur since in modern practice these openings are often carried full height to the frieze board, soffit or slab above.

The function of joint reinforcement (i.e. metal bonding mesh) is not to eliminate cracking in masonry veneers but to reduce it and prevent the formation of conspicuous shrinkage cracks.

Joint reinforcement becomes effective when shrinkage stresses commence. At this time the stresses are transferred to, and redistributed by the steel.

The result is evenly distributed to produce very fine cracks hardly visible to the naked eye.

Joint reinforcement should be located as follows:

In the first and second bed joints immediately above and below wall openings. Alternatively it may be used above the window with a conventional control joint below. It is difficult to align a vertical control above a window due to the influence of for example a steel lintel angle that is required to bear 200 mm beyond the jamb.

The reinforcement should extend not less than 600 mm past both sides of the opening. Figure 10.

This reinforced joint method is not a usual technique.

Note that this type of reinforcement under window openings is to deal with local stresses and therefore should not be regarded as replacing conventional control joints in any adjacent long length wall panels.

Where control joints are used they should be built from full and half-length units to maintain the bonding pattern.

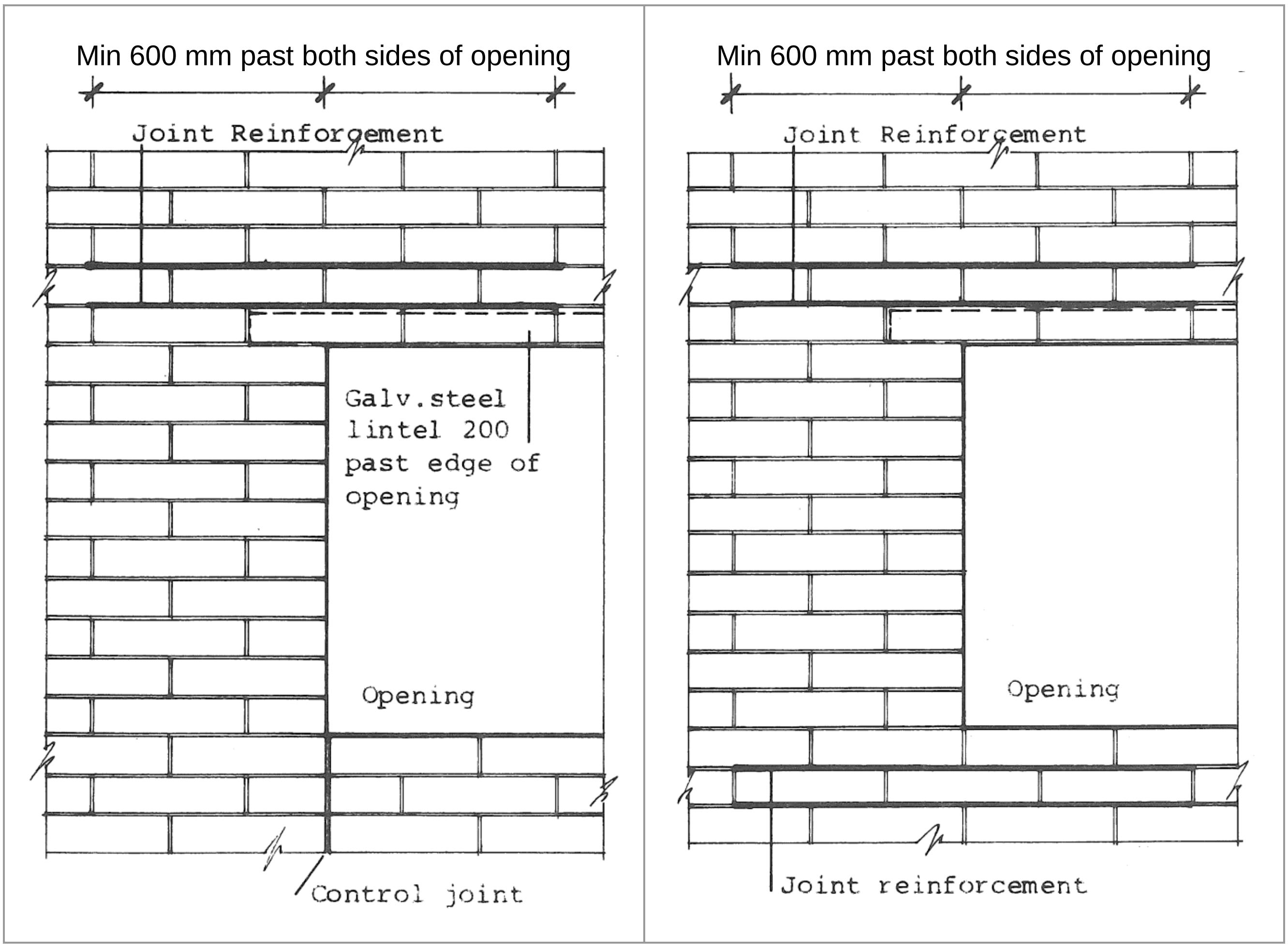


Figure 10: Control Joints and In Joint Reinforcement

An expansion control joint should be packed with a bitumen impregnated compressible filler strip and caulked with a sealant on the outside of the wall (Figure 11). A shrinkage control joint may be formed by raking onto the vertical joint by 20/25 mm. A sealant would be optional since any moisture penetrating the joint would be collected by the cavity construction. In areas of high wind/rain exposure a sealant would be advisable to reduce water transfer to the cavity (Figure 11).

NOTE:

Control joint details may vary according to individual manufacturer's recommendations.

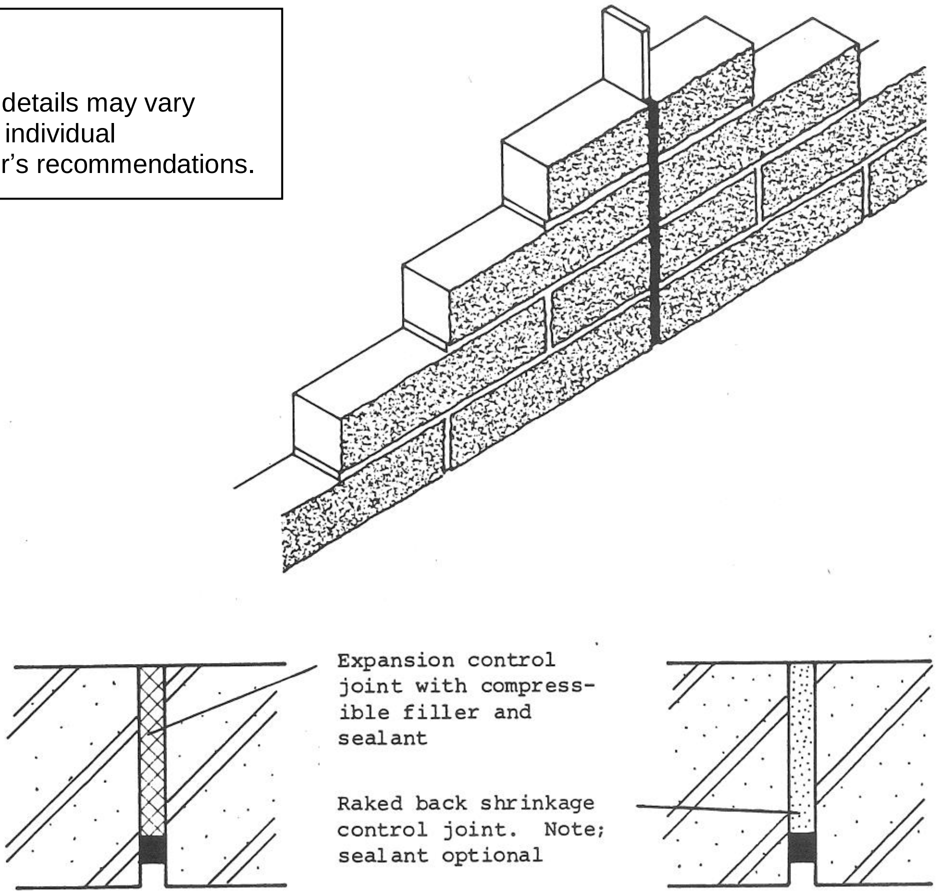


Figure 11: Control Joint Detail

Seismic Separation Joints

Veneers are a non structural element and as such are expendable under severe earthquake action. Examination of seismic damage to veneers however points to consistent problems associated with corners of buildings.

When a house has been built with masonry internal bracing, the movement at the top of a storey height is slight, approximately 1 mm. By contrast a house built using timber frame bracing has been shown to move up to 40 mm at the top of the storey.

Essentially the stiff veneer panel cannot accommodate such 40 mm movements and severe cracking occurs. The problem is particularly related to corners where whole bonded wall quoins become displaced.

To reduce veneer wall damage at corners it is preferable to form a non-bonded corner allowing for some differential movement.

The design for providing 40 mm of movement involves special closure flashings (see Figure 12) which will be distorted during an earthquake.

The replacement of the flashings would probably involve significant demolition and rebuilding. However, the risk of losing substantial corner sections of falling veneer would be reduced.

There are other ways of reducing the 40 mm maximum requirement by stiffening the timber frame for example by incorporating reinforced masonry panels. In this case a simpler corner detail which is just an extension of the control joint philosophy could be applied (see Figure 12).

The use of a backed sealant in respect of weather penetration is optional for veneer cavity wall construction. A suitable dual purpose product could be an expandable bitumen impregnated foam such as Compriband.

Essentially the use of a non-bonded corner is a move away from traditional construction but nevertheless is considered to have merit in dealing with movements arising from earthquakes.

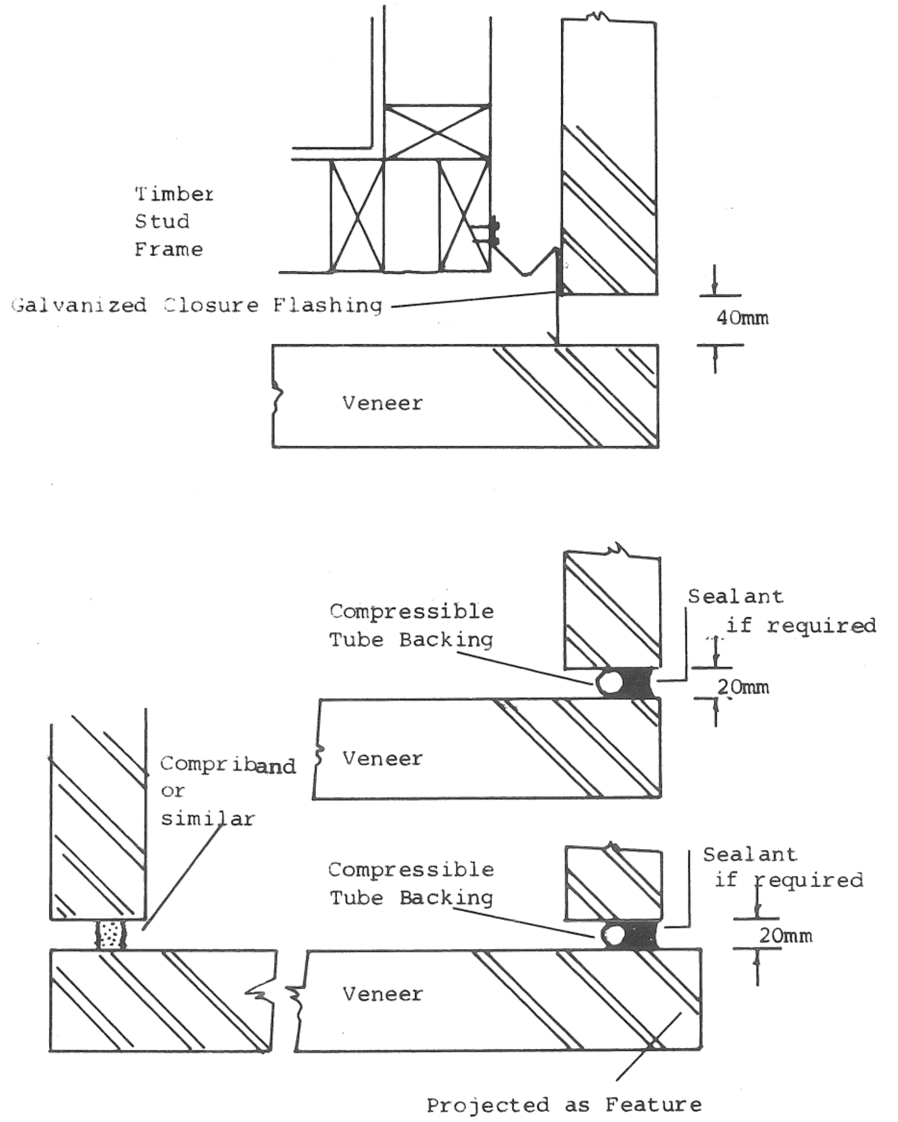


Figure 12: Seismic Control Joints

Construction Details

Veneer construction is illustrated in the Construction Section showing details at foundations F 4 and 7, intermediate floors I 6 and roof R 1.

Details shown in figures 13, 14, 15, 16 and 17 show joint, head, sill or threshold details for windows and doors.

Table 2 (page 13) is taken from E2 AS1/NZS 4229 giving the steel angle lintel spans permitted.

Lintels should bear at least 200 mm onto the supporting jambs.

Lintel steel shall comply with the durability aspects of Table 3 (page 13).

Table 2: Table E5 – Veneer lintel table – Steel angles (see E6.1)

Maximum lintel span (mm)	Thickness of veneer (mm)					
	70 mm			90 mm		
	Maximum height of veneer supported (mm)			Maximum height of veneer supported (mm)		
	350	700	2000	350	700	2000
2000	60 x 60 x 6	60 x 60 x 6	60 x 60 x 6	60 x 80 x 6	60 x 80 x 6	80 x 80 x 6
2500	60 x 60 x 6	80 x 80 x 6	80 x 80 x 6	80 x 80 x 6	80 x 80 x 6	80 x 80 x 8
3000	60 x 60 x 6	80 x 80 x 6	125 x 75 x 6	80 x 80 x 6	80 x 80 x 8	90 x 90 x 10
3500	80 x 80 x 6	80 x 80 x 6	125 x 75 x 6	80 x 80 x 8	90 x 90 x 10	125 x 75 x 10
4000	80 x 80 x 8	125 x 75 x 6	125 x 75 x 10	80 x 80 x 10	125 x 75 x 6	150 x 90 x 10
4500	125 x 75 x 6	125 x 75 x 10	–	125 x 75 x 6	125 x 75 x 10	–
4800	125 x 75 x 6	125 x 75 x 10	–	125 x 75 x 6	125 x 75 x 10	–

NOTE:

(1) All sections are steel angles.

(2) Stainless steel sections of equivalent section modulus are a permitted alternative.

Table 3: Table E2 – Protection for masonry veneer lintels supporting masonry veneer using AS/NZS 2699.2 (see E6.1)

Location (NZS 3604 Exposure Zones)	Grades 316, 316L or 304 stainless steel or 600 g/m^2 galvanising on mild steel plus duplex coating	600 g/m^2 galvanising on mild steel or 300 g/m^2 galvanising on mild steel plus duplex coating
Zone B	Yes	Yes
Zone C	Yes	Yes
Zone D	Yes	No

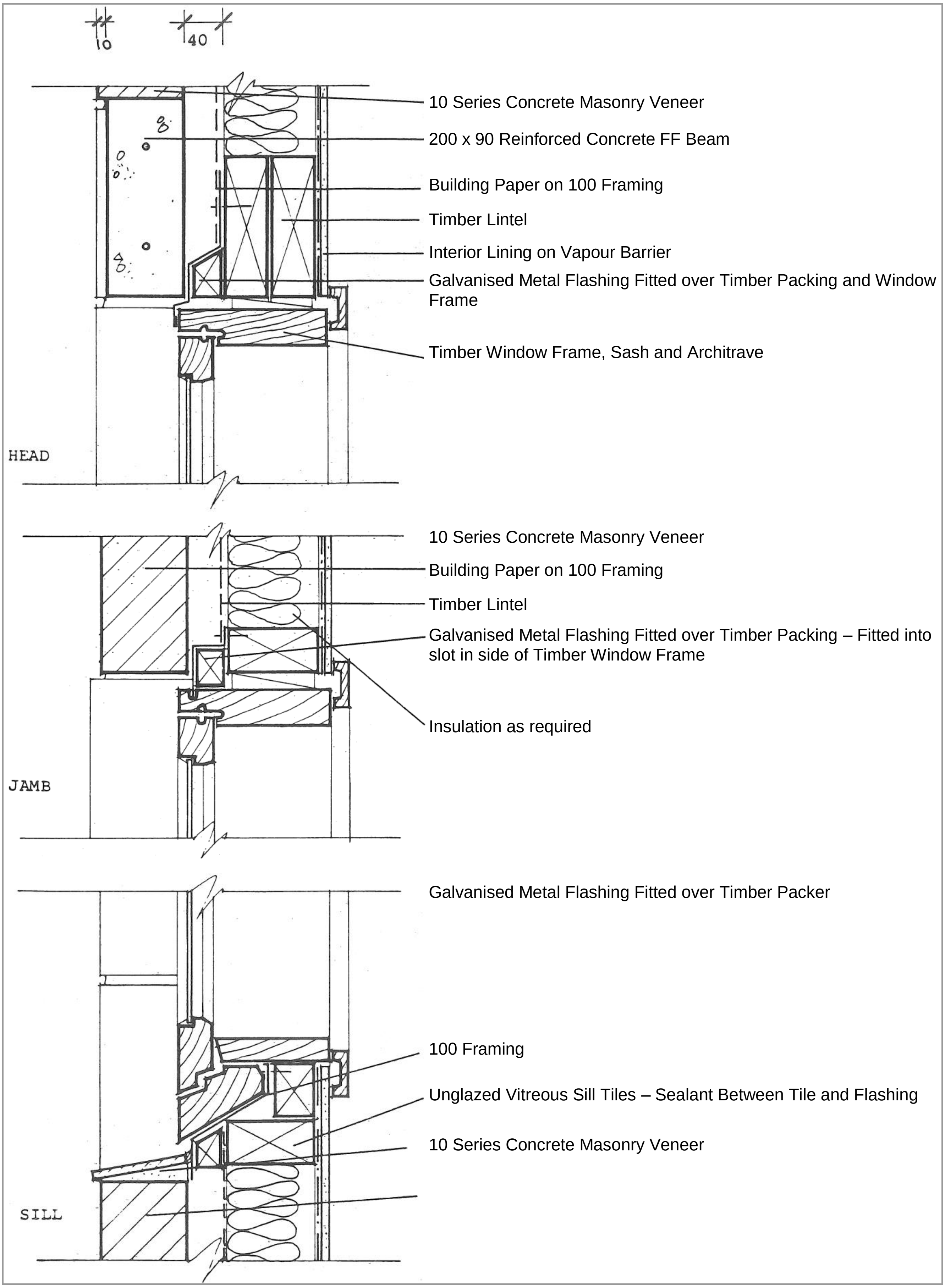


Figure 13: Veneer Details – Timber Windows

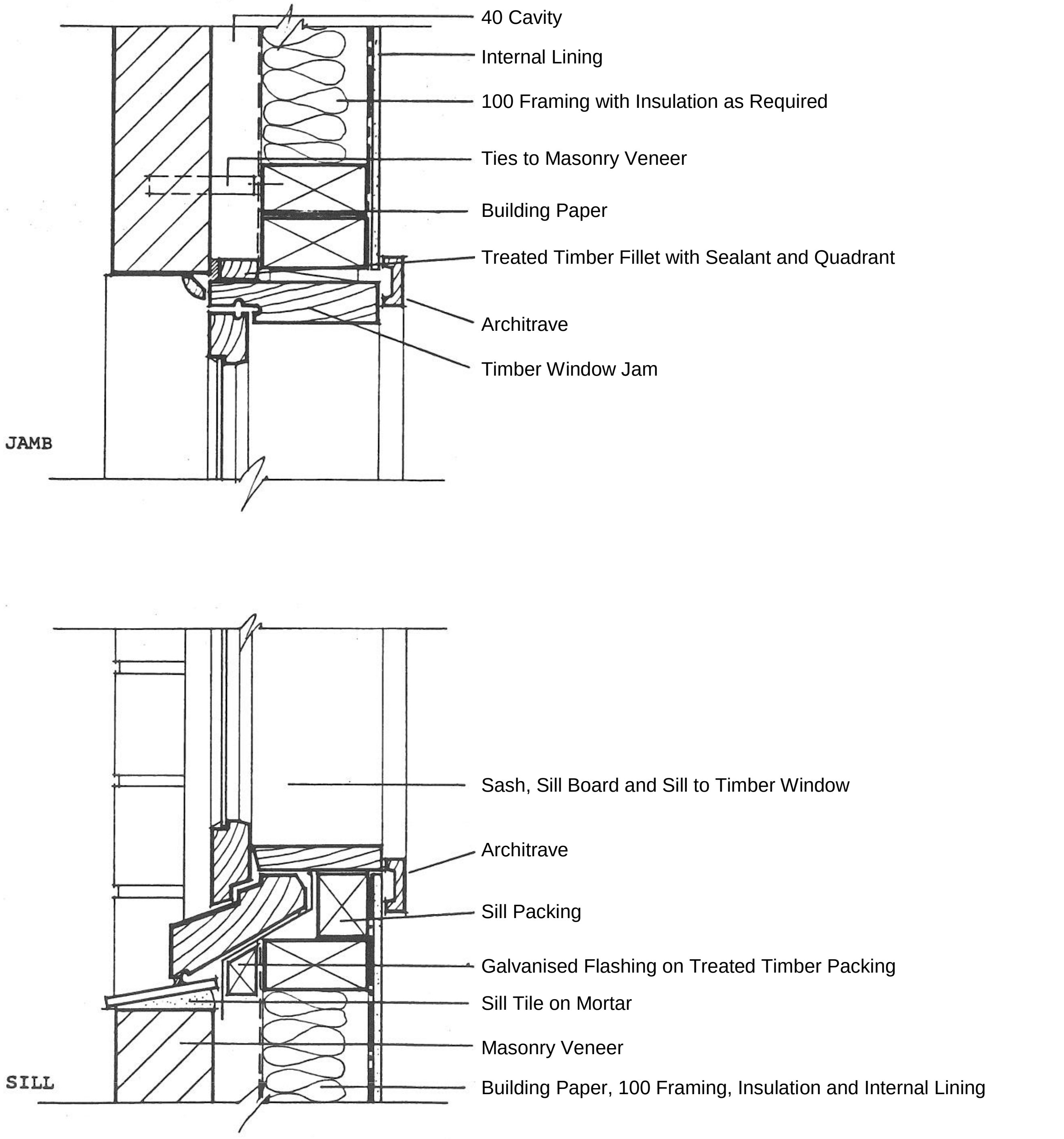


Figure 14: Jamb and Sill Details – Traditional Timber Windows

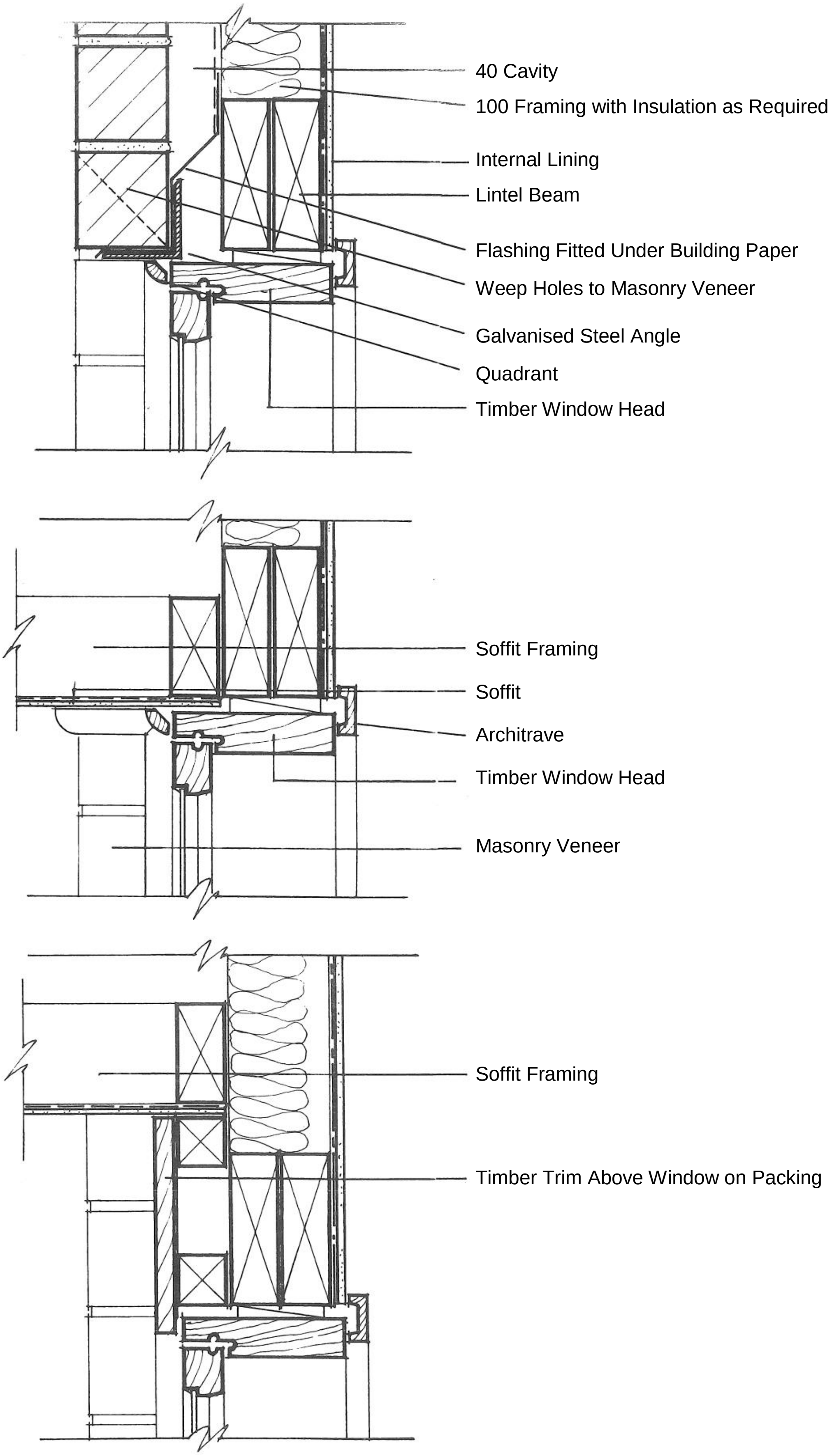


Figure 15: Timber Window Head Details

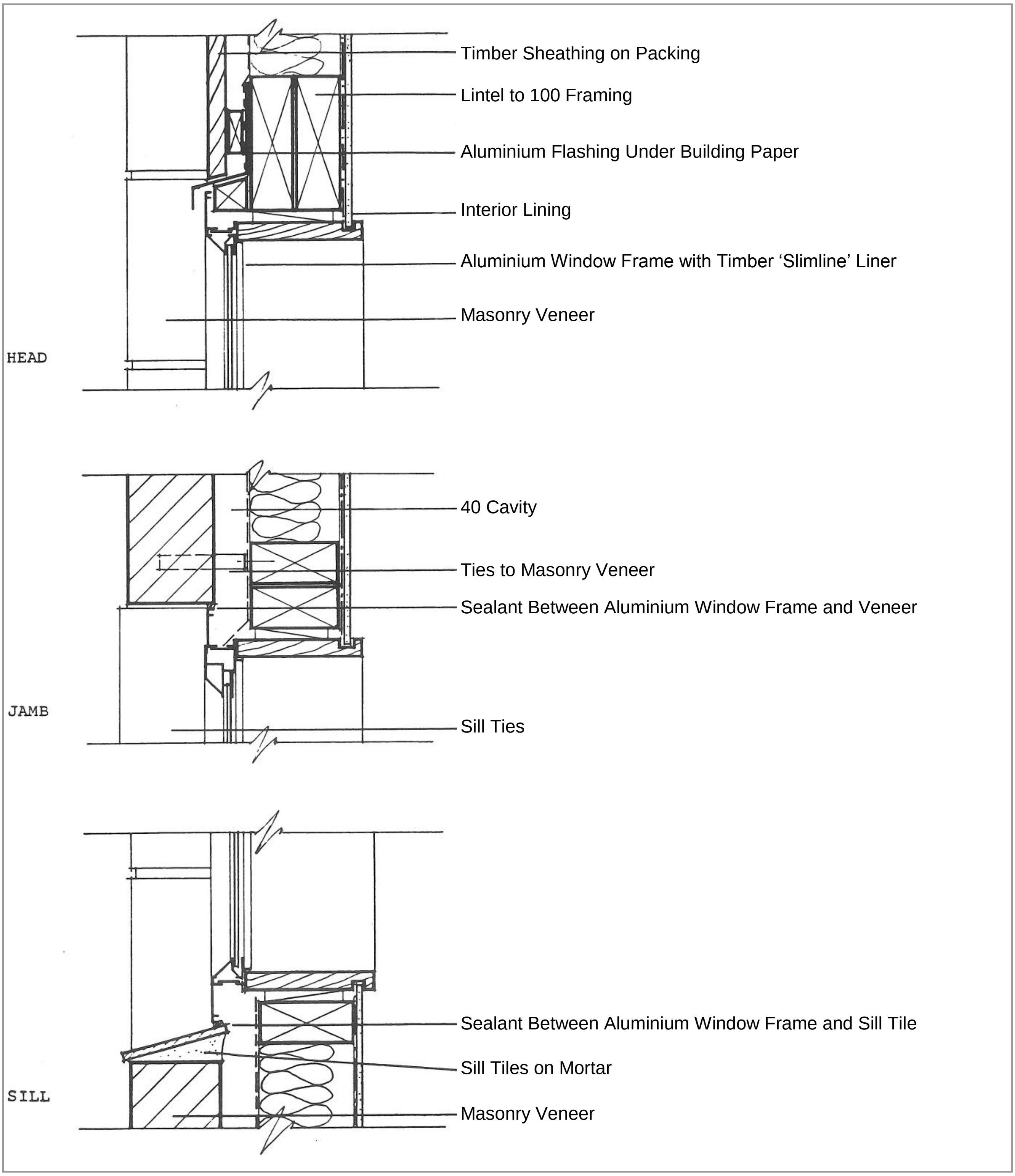


Figure 16: Aluminium Window Details

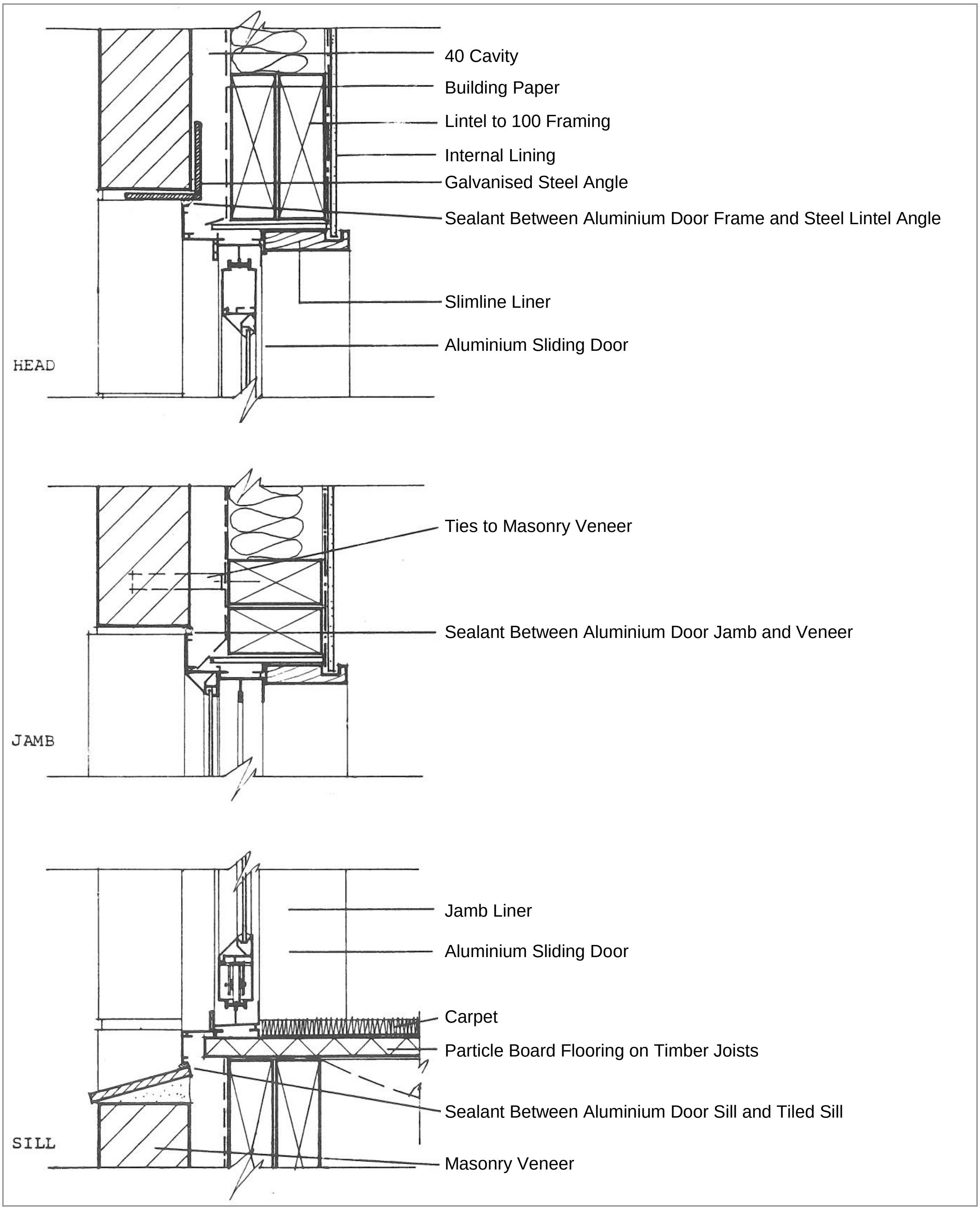


Figure 17: Aluminium Sliding Door Details