

5

Openings in Masonry Walls

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As we did with floors, we can classify openings in walls roughly by the size of opening required.

So we will look at:

- Openings for small pipes and cables <50 mm diameter
- Openings for pipes and ventilators >50 mm diameter but <225 mm
- Openings in excess of 225 mm – large openings.

For small pipes and cables

Openings for small pipes and cables can now be drilled with a power tool fitted with an appropriate drill bit – solid for holes up to about 50 mm and a core bit for larger holes up to about 150 mm diameter. There are even some specialised forms of bit which can cut large diameter holes but they generally require water cooling. All that is required is a powerful enough tool, core bits requiring the greater power.

Because of the extensive use of cavities, sleeves must be built in across the full width of the wall to prevent the leakage of pipe contents into the cavity and to prevent vermin getting into the cavity. Typical examples of drill bits and a sleeve in a masonry cavity wall are shown in Figure 5.1.

Sleeves should be built in with a slope down and towards the outer face of the wall to prevent water running through the sleeve. This does not need to be excessive – the sketches exaggerate the slope.

Sleeves can be made of any solid drawn pipe material with a bore which will allow an easy fit for the service pipe or cable passing through. Typically, copper piping or plastics piping can be used. Ferrous material should be avoided, as should aluminium which corrodes in contact with a strong alkali. Plastics pipe does seem to be the favoured choice on building sites one visits, but it is uncertain whether or not compatibility with cable insulation etc. has been considered in the choice of pipe material.

Joints of the service pipes and cables are not allowed in the sleeve. With soft-walled pipes and cables, the ends of the sleeve should be rounded or be fitted with some form of cushioning to prevent wear on the pipe or cable. Chapter 4, Timber Upper Floors, gives a description of ‘cover plates’ where small pipes etc. pass through a floor. These can be used with holes in walls.

If the space between the sleeve and the pipe or cable is to be sealed, this should be done with a non-setting mastic or sealer. Take care to ensure that it is compatible with the material of both sleeve and service pipe or cable. The space should be left large enough to make

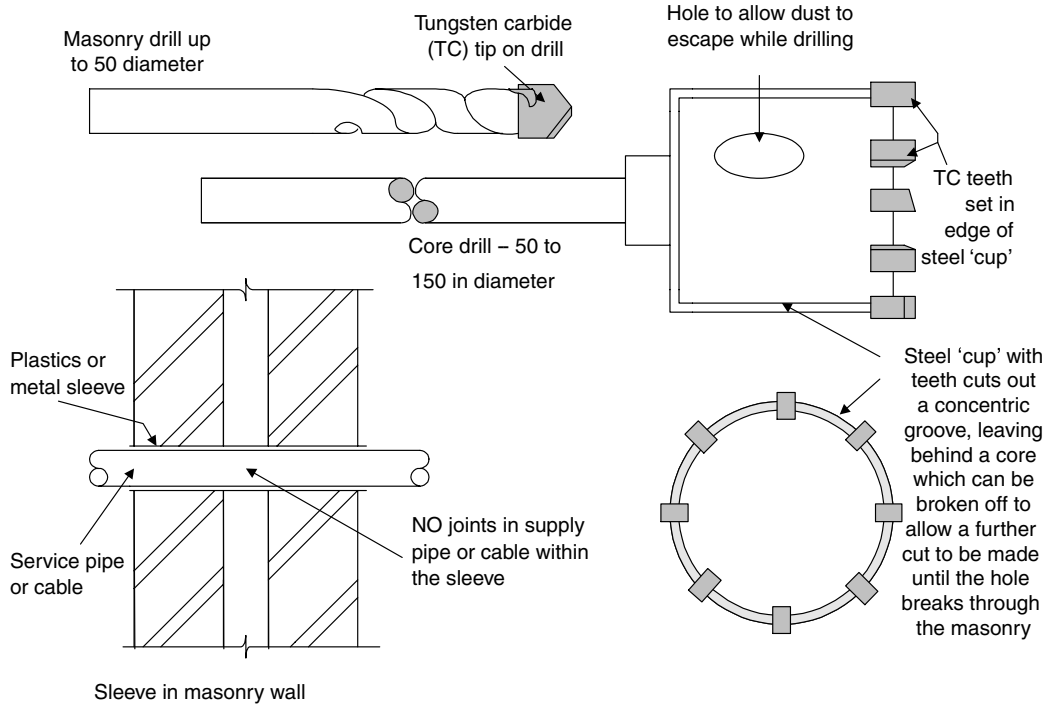


Fig. 5.1 Drills for drilling through walls.

it easy to inject the mastic. The whole space from end to end is never sealed, only about 25 mm at each end.

For larger pipes and ventilators

The only large pipes to pass through domestic walls are generally soil pipes or flue pipes – occasionally air extract ducts. In both cases the norm is to cut a hole in existing walls or build in the pipe or flue with mortar, fitting the masonry units around them. The cutting is done with a hammer and chisel or a core drill in a power tool. The latter causes much less damage to the new masonry.

In the case of a flue, the heat generated may be sufficient to damage cavity insulation. In such a case an approved sleeve (metallic or asbestos cement pipe) with proper clearances must be built into the wall. Manufacturers' literature should give the necessary advice on the type of material to use for a sleeve and the clearances required, together with the

expected temperatures with various fuels for which the flue is suitable.

For pipes, ducts and flues up to 150 mm diameter, holes would be formed or drilled to coincide with a junction of two bricks or blocks so that these units can be **saved over** rather than use a separate lintel, as shown in Figure 5.2. Also shown is a ventilator (*not* an airbrick) which generally tends to be rectangular in section and made in brick coordinating sizes. For ventilators up to one brick wide therefore, there is no need to do anything other than ensure that two bricks in every half brick thickness are evenly distributed over the ventilator opening. Saving over relies on the self arching effect of masonry.

Large openings in masonry walls

Large openings are made for doors, windows, hatches and the like. What differentiates them from previous openings is the need to provide extra support over the opening as the self

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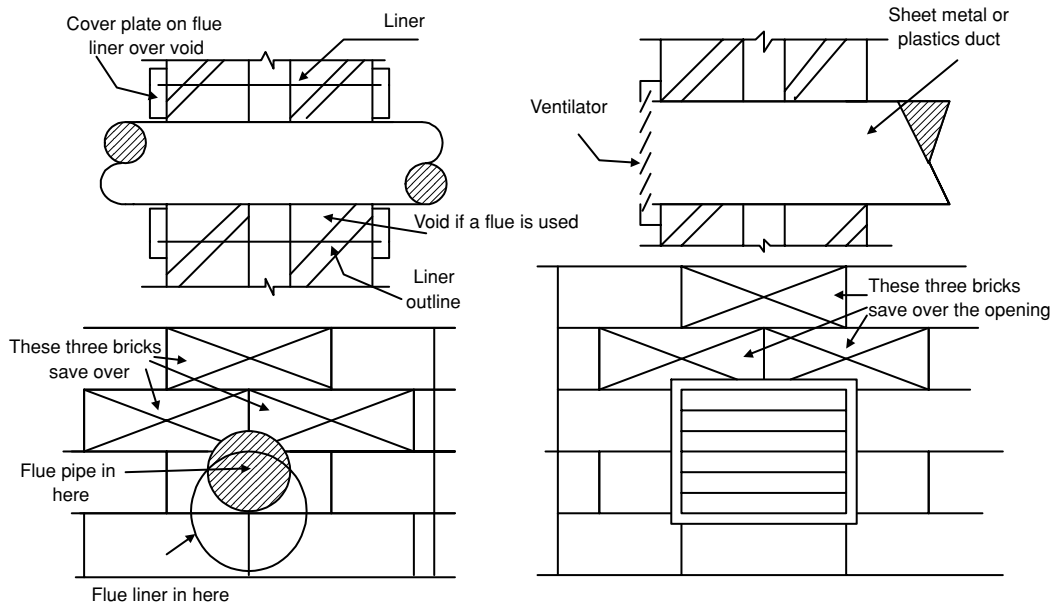


Fig. 5.2 Saving over in brickwork at ducts, pipes and ventilators.

arching effect can only be partially successful. Support is provided by **lintels**.

Lintels can be made from a wide variety of materials and a variety of shapes. Materials include stone, reinforced precast concrete, prestressed concrete, cold rolled mild or stainless steel sections, and hot rolled mild steel sections. Old buildings may have timber lintels or 'safes' but these are no longer used and should always be replaced during any refurbishment work. Shape will be discussed as we look at each application.

There is some terminology to learn. Any large opening has:

- A bottom – the sill for windows or threshold for doors
- A top – the head which has a soffit or soffite
- Two sides – the jambs which have reveals.

Once a frame is put into the opening, the soffit is divided into an inner and outer soffit, the reveals are divided into inner and outer ingoes, and the sill into inner and outer sills. These are all illustrated in Figure 5.3.

Cavity walls have the cavity closed at the head, jambs and sill or threshold. A further feature is the positioning of the door or

window frame within the opening. Where there is a risk of wind-driven rain, the frame is positioned back in the wall thickness, thus giving shelter to the joint between frame and wall. This situation arises generally in Scotland and in northern and western and south-western England, Wales and Northern Ireland. In more sheltered areas, such as the Home Counties, Norfolk and Lincolnshire, the frame was traditionally placed flush with the outside face of the wall, and the majority of textbooks showed frames in this position. The situation has changed somewhat and the textbooks now tend to show the frames set back behind the face of the wall. Setting frames flush with the outer face of the wall had implications for making a weatherproof joint between frame and wall which did not rely on some form of mastic. Like flattery, mastic is the last resort of the rogue builder in situations like that. Mastic is advocated in the details which follow but it is not relied on entirely; the detail itself has to be correct first.

Another area for concern was the closing of the cavity at head, jambs and sill. With the frame so far forward of the cavity, closure was haphazard in practice and the positioning of

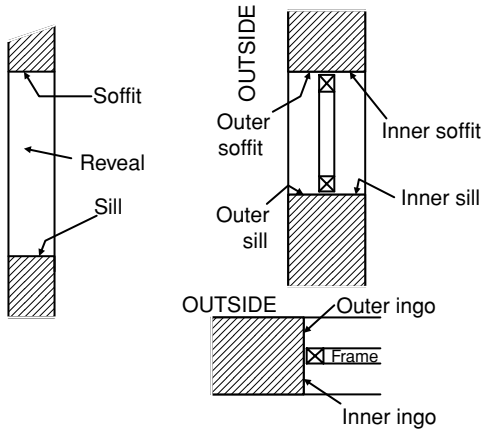
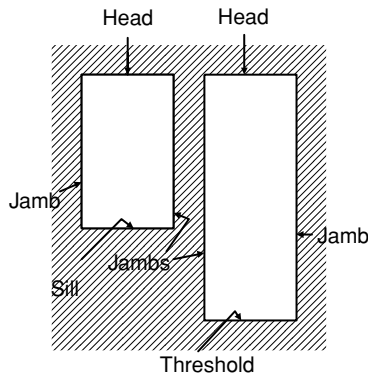


Fig. 5.3 Terminology associated with openings in walls.

the DPC at jambs and head was never quite satisfactory.

This chapter will deal with frames set back from the face of the wall – indeed the outer face of the frame should align with the inner face of the outer leaf of masonry in a cavity or timber frame wall construction. The details shown all work, and work well. They function in the most extreme weather conditions in the UK.

Closure of cavities was traditionally, pre 1970, done by:

- Making inner lintels wide enough at the head with a DPC at the closure
- Making sills or thresholds wide enough, with a DPC at the closure

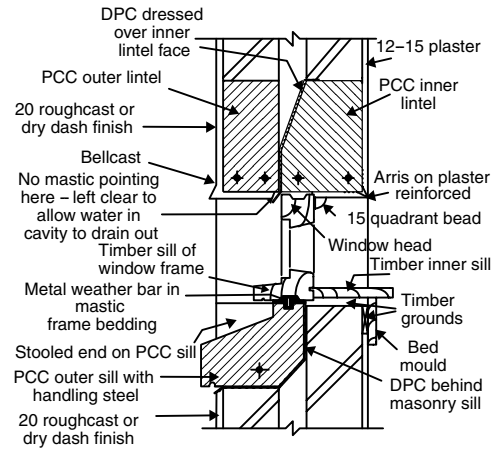


Fig. 5.4 Pre-1970s sill and head details, rendered external finish.

- Returning the inner leaf of masonry against a DPC layer on the outer leaf at the jambs.

These details were sound and have stood the test of time since the early 1900s with only minor adjustment. The principles should not be abandoned for the sake of fashion or whim. They are illustrated in Figures 5.4 and 5.5 in a cavity wall which has a roughcast finish.

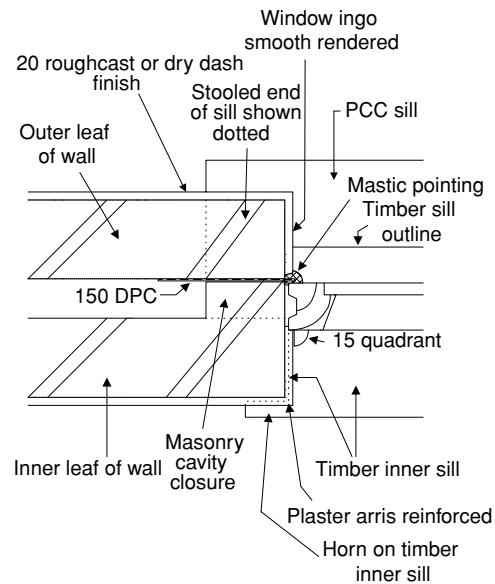


Fig. 5.5 Pre-1970s jamb detail, rendered external finish.

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A few important points to note about the details:

- PCC (pre-cast concrete) lintels of that period were frequently only reinforced at the bottom. Top and bottom reinforcement with links is now much more common.
- The roughcast finish stops short of the head and jambs of the timber frame and under the PCC sill. At both head and sill this allows water to drain out. This should *not* be filled with mastic. At the jambs, the space is used to seal frame to wall to DPC with mastic.
- Joints of plaster to timber frame are covered with a timber quarter round beading to hide the joint which would inevitably show a crack as the timber and plaster shrank away from each other.
- Good joinery practice would have the bed mould tongued into a groove in the timber inner sill. Economics now dictates otherwise.
- Had the wall been finished with facing brick, many architects would have left the

brickwork in exactly the same position as the common brick shown, relying in that case on the mastic alone to give a weather seal instead of having the roughcast provide a check or rebate. It would be better to have this small rebate built into the wall as shown in the masonry only outlines of Figure 5.6.

Figure 5.7 is a photograph of the sill and part of the jamb of an opening in a blockwork wall. The details shown are the 200 thick outer leaf of masonry; the sill with the upstand with weather bar groove; the weathered surface of the sill; the stool on the end of the sill; the lack of protection to the finished surfaces of the sill and how dirty they are – not a good site.

Figure 5.8 is a photograph of the same window opening which shows both sill and lintel and masonry mullion. The mullion is bedded between sill and lintel but is also restrained in position by metal dowels both top and bottom. Figure 5.9 shows how this would be done. Note how the sill has a sloping surface generally to make water run to the front edge, and how the underside of the projection has a

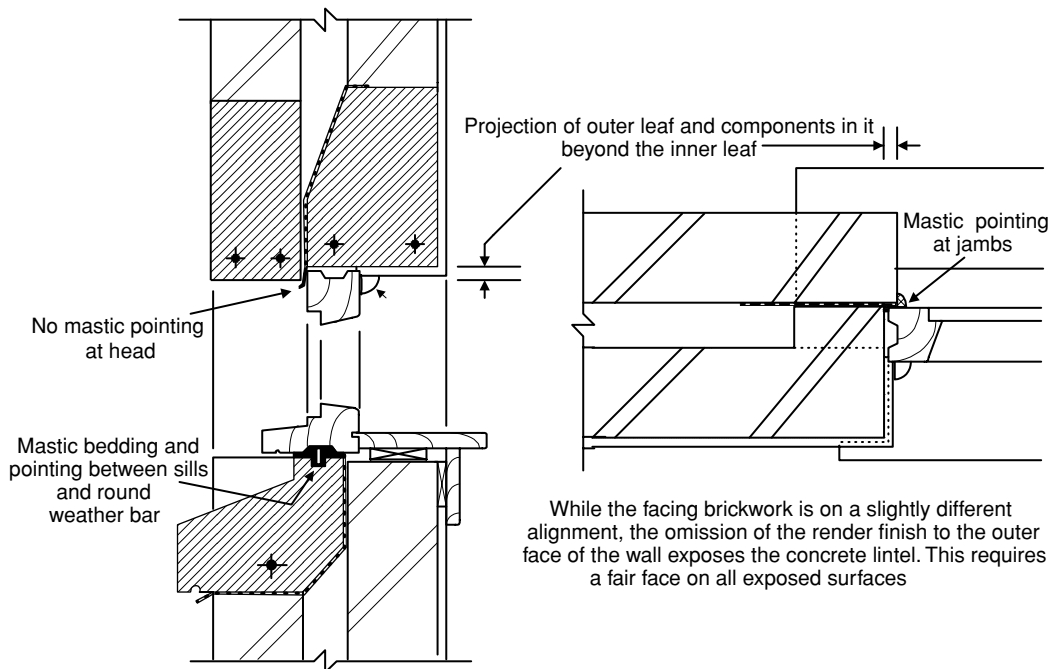


Fig. 5.6 Pre-1970s sill, jamb and head details, facing brick external finish.



Fig. 5.7 Photograph of 1990s sill and jamb.

groove – the **throating** – to prevent water running back onto the face of the wall. Because the upper surface slopes, the mullion sits on a **stool**. This device is also used at the ends of sills which are built into walls, to allow the masonry to be bedded on a horizontal surface.



Fig. 5.8 Photograph of 1990s head, sill and mullion in artificial stone.

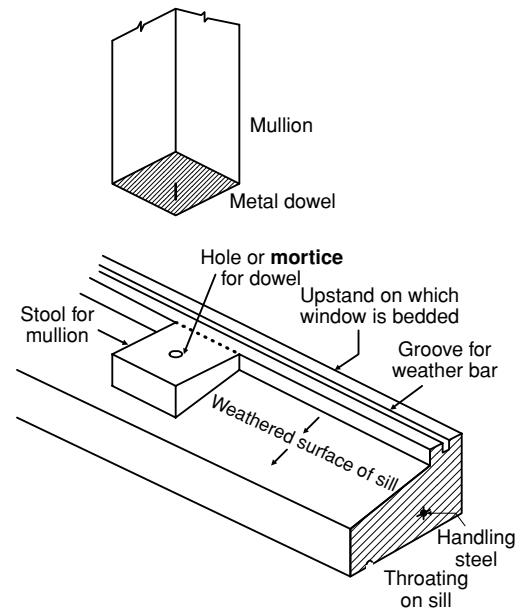


Fig. 5.9 Detail of mullion-sill junction.

Figure 5.10 is a photograph of the inside of another window on the same site, which shows a galvanised steel lintel holding up the inner masonry leaf over the opening. Steel lintels are sketched a little later in the text.

It is important to note that frames for windows or doors are only fastened to the walls through the jambs and that in the traditional methods this fastening went into the masonry, closing the cavity.

Figure 5.11 is a photograph of a cavity closure in blockwork. Note how a cut block closes



Fig. 5.10 Steel lintel at inner leaf of opening.



Fig. 5.11 Detail of checked jamb.

the cavity and bonds into the inner leaf in alternate courses, and that a cut of blockwork is used for the intermediate courses, all bedded up solid in mortar and with a vertical strip of DPC between closure and the outer leaf. Compare these photographs with Figure 5.4, the general sections.

For nailing to plugs, proprietary framing anchors or **cramps** are the most common methods, although some window frames are still only wedged into place. More of this when we examine windows in Chapter 9.

Note that in Scotland, traditional practice is to form the opening and then fit the frame into the opening, whereas the practice in the rest of the UK is almost entirely to set the frame up on the sill, rack or brace it vertical, and then build up the rest of the wall round it.

The window sections shown in all the drawings so far have been based on standard single glazed casement windows. A range of sections will be studied in Chapter 9, Windows.

The practice of building in frames as the wall is built up means that fixings are generally

galvanised or stainless steel 'cramps' fixed to the back of the frame and bedded into the mortar joints. Screws should be used with timber frames, and machine or self tapping screws with metal or plastic frames. A typical fixing is shown in Figure 5.12.

Since 1970 there have been several editions of the Building Regulations, and the stricter requirements regarding U-values of walls and the need to avoid **cold bridging** have meant that the traditional details have had to be updated. This is shown in Figures 5.13 and 5.14.

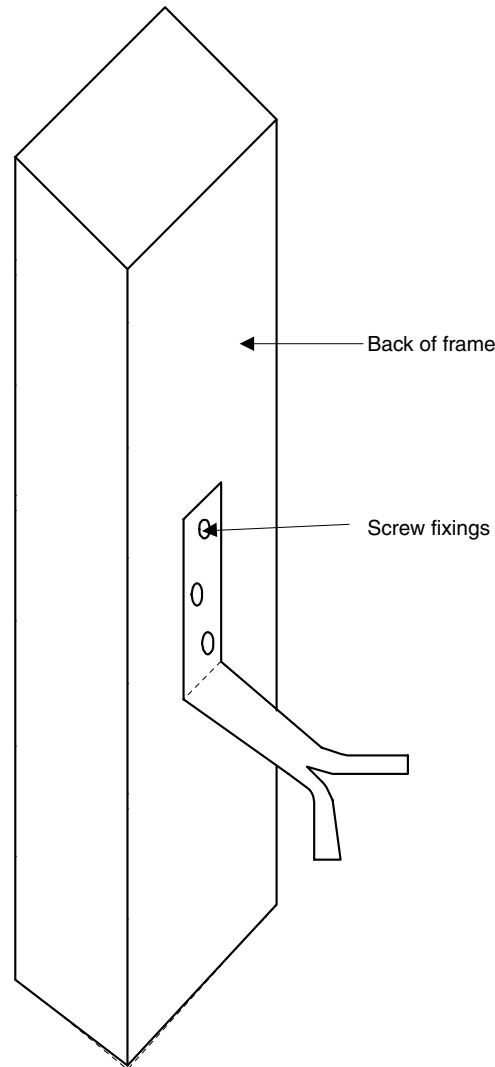


Fig. 5.12 Window frame cramp.

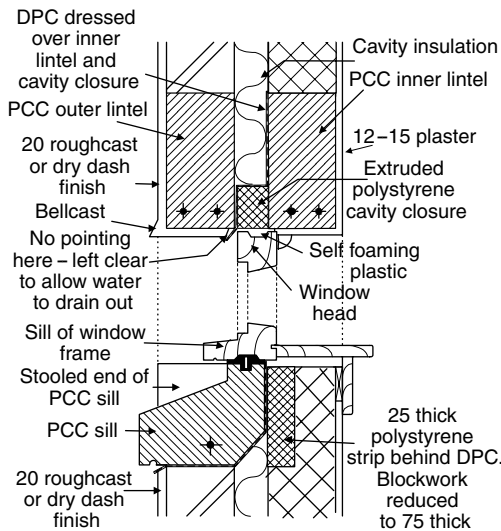


Fig. 5.13 Eliminating cold bridging at sill and head.

Variations on finishing

The figures which follow show variations on the finishing of various parts of openings incorporating different materials and

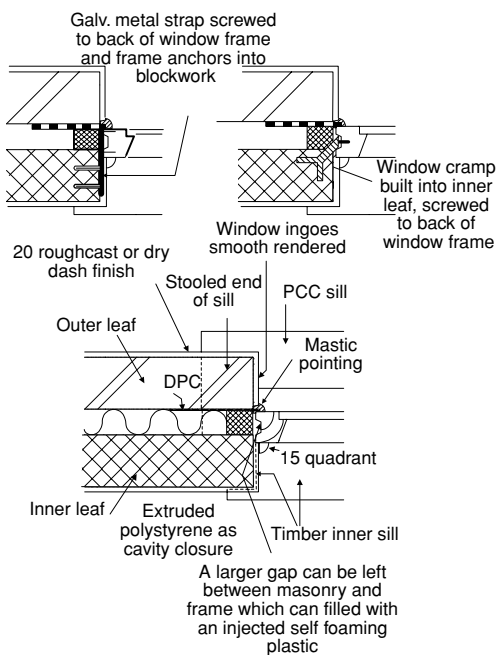


Fig. 5.14 Alternative jamb arrangements and cavity closure to eliminate cold bridging.

components but always including wall insulation and avoiding cold bridging in terms of the current Building Regulations. The good practice in relation to the positioning of DPCs and frames, and mastic pointing in appropriate places, have all been maintained from the pre-1970 details.

Textbooks will show weeps formed or built into perpend of the outer leaf of brickwork over window and door openings. This cannot be done when lintelling with PCC and/or a roughcast finish. How do you build a weep through a solid concrete lintel? There were two possible routes for water in the cavity to use to escape. The first was between DPC and outer lintel, a space which was never pointed with mastic, as has been noted on the previous figures. The second was off the ends of the DPC into the cavity itself, but at the back of the outer leaf. This was made easier by the simple expedient of having the DPC project about 100 mm beyond the end of each lintel. With no insulation filling the cavity, water running off the low end of the DPC did so against the inner face of the outer leaf and was in no danger of crossing back across the cavity.

In recent years in the construction press, much has been made of **cavity trays**. The DPC over inner lintels is such a tray and in the bad old days they formed up from hessian-based bituminous DPC where appropriate. There is a widely held opinion that the ends of *all* cavity trays should be 'boxed' to prevent water running off the end into the cavity. In many instances this is correct but is not really necessary at ordinary PCC lintels unless the cavity is filled with insulation. There are three solutions to the problem: only part fill the cavity and let the water run off the ends of the DPC in the usual manner, or put the insulation somewhere else, completely inside or outside the wall, or redesign the lintelling when we have a facing brick finish.

Alternative lintelling arrangements are shown in Figures 5.15, 5.16 and 5.17. Figure 5.15 shows a steel lintel made up from three pressed sections spot welded together, zinc plated, passivated and painted in the factory. A separate DPC is shown but

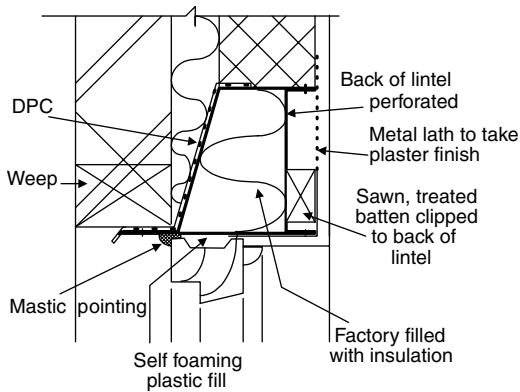


Fig. 5.15 Pressed steel inner lintel (1).

some manufacturers do not recommend one. Figure 5.16 shows an IG lintel, available in galvanised steel and stainless steel. Sealing the window frame and foam filling etc. is all the same as the earlier lintels. Figure 5.17 shows a very old form of lintelling when using a facing brick outer leaf: the mild steel angle iron. Galvanised angles are more readily available and are to be preferred to plain steel. Note that the

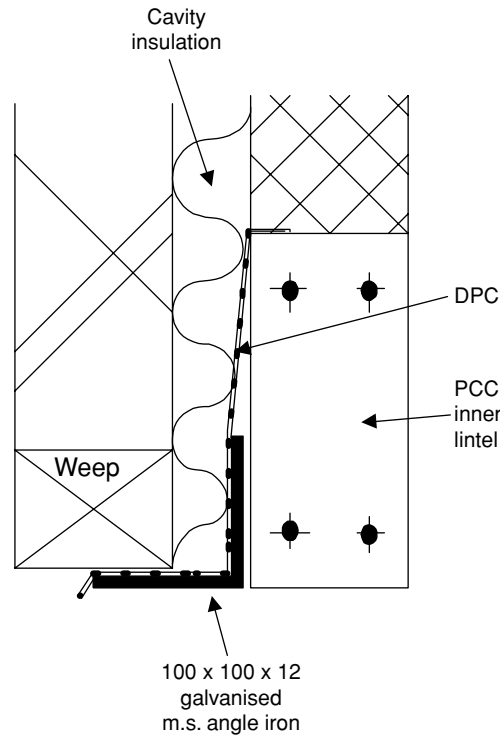


Fig. 5.17 Angle iron lintel.

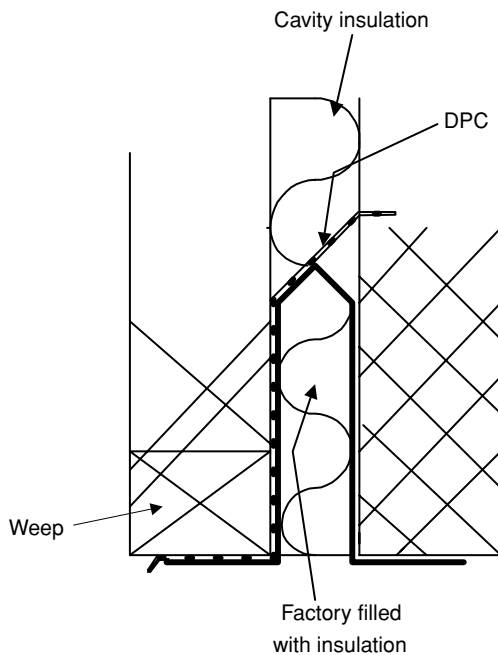


Fig. 5.16 Pressed steel lintel (2).

inner lintel here is rectangular and that a DPC is dressed over it and down over the angle to project beyond the angle iron. DPC projection is necessary in all the details where it is shown to provide a good drip and prevent water being drawn under the lintel and so coming in contact with the frame. Mastic pointing *is* used at the head of the frame.

The illustrations so far show an outer leaf of facing brick. All of these lintel alternatives can be used with a roughcast or dry dash finish on common brick or blockwork. The general detail does not alter significantly. The weeps can be blocked when the roughcast is applied and, if possible, the use of weeps with a removable strip or a strict regime of cleaning up after rendering has to be adopted. Figure 5.18 shows a possible solution using the IG lintel and without using weeps, instead using the natural porosity of blockwork to allow water to escape. The detail would be the same for any steel lintel.

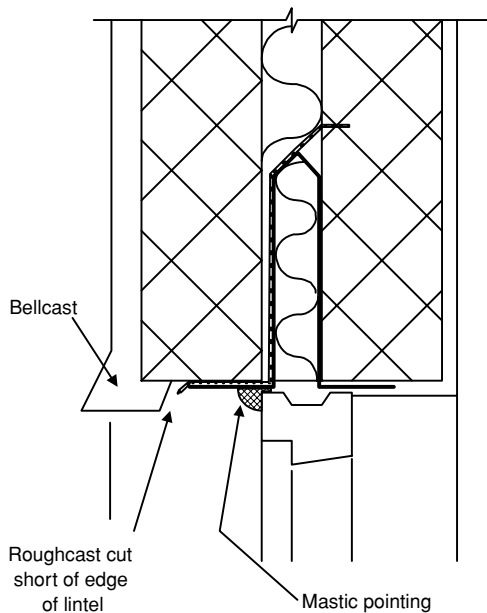


Fig. 5.18 Pressed steel lintel (3).

Before leaving lintels the term ‘bellcast’ requires expansion. It is obvious how this projection of a roughcast or rendered finish got its name. It is not formed directly by applying the mortar in that shape; that would not be possible. Instead, early craftsmen fixed a temporary batten to the masonry background and worked to the thickness of that batten. Modern practice uses either a galvanised steel bead or a plastic bead, which is fixed to the wall and the render brought to that. Figure 5.19 shows a typical section and its application, while Figure 5.20 is a photograph of three galvanised beads, from the left:

- The bellcast bead.
- A render stop bead used to finish off plaster at an open edge of a wall or where separating plaster or render finishes either side of an expansion joist etc.
- Angle bead for protecting arrises in plasterwork. It features in most of the sketches in this book on openings in masonry walls.

Note that all the beads feature a mesh-like finish to the edges which are bedded into the plaster or render. This mesh is **expanded**

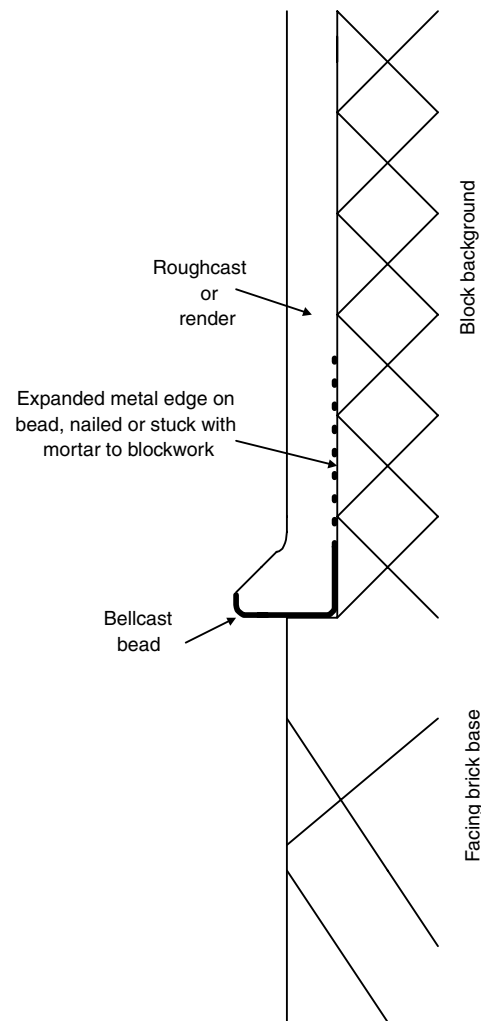


Fig. 5.19 Bellcast bead.

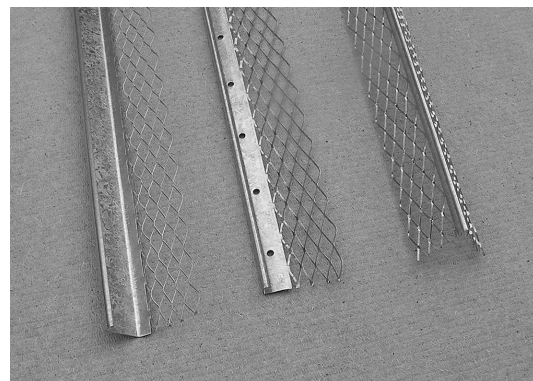


Fig. 5.20 Photograph of bellcast bead and corner bead.

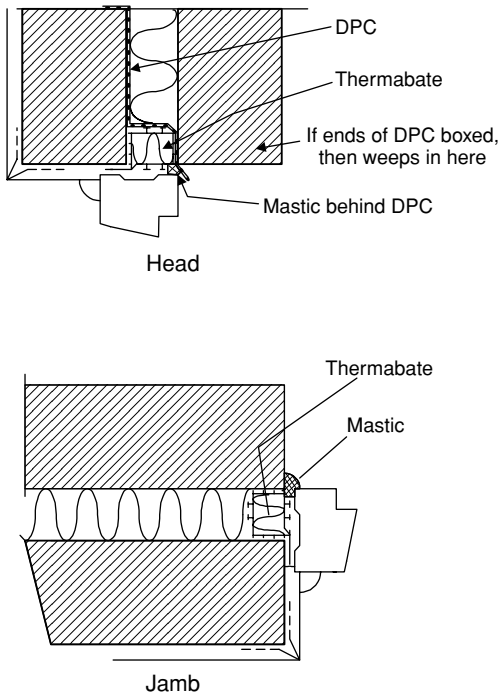


Fig. 5.21 Proprietary cavity closure at head and jambs.

metal and is made by slitting the metal sheet and then pulling it apart.

The only alternative to the use of masonry or extruded polystyrene strip to close cavities at jambs is the use of a proprietary closure. The component is an extruded uPVC section filled with expanded plastic foam. The outside has grooves or ridges to provide a fixing point for fittings and to direct water flow. Because the PVC outer is waterproof, there is generally held to be no need to place a separate DPC against the outer leaf. This is *not* necessarily the case when the frame is set back in the opening, as is common in much contemporary construction. Figures 5.21 and 5.22 show how this can be dealt with.

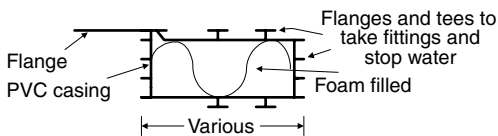


Fig. 5.22 Schematic of cavity closure.

Alternative sill arrangements

Figure 5.23 shows a PCC sill with a proprietary closure immediately under the sill of the window frame. The flange of the closure should be over the PCC sill, bedded in mastic and trimmed back if necessary. The projection of the timber window sill may have to be larger than usual. Note the use of and position of the DPC. Provided the under sill DPC starts on the inside face of the closure, there is no need to place DPC between the closure and the outer leaf at the jambs detail.

An alternative shape for a PCC sill is shown in Figure 5.24. This shape can be cast one course high, although it makes a very slender sill if there is a wide window opening.

Tiles, both plain roofing of clay or concrete and quarry floor tiles, make good sills as they are made to prevent the entry of water. The detail is illustrated in Figure 5.25. They must, however, be laid in a minimum of two courses with the bond broken and in a strong mortar, mix 1:5 or even 1:4. Any DPC must be brought down at least one, preferably two, brick courses below.

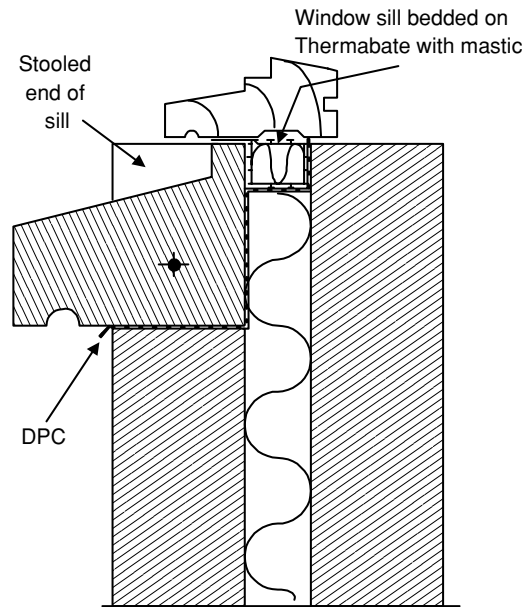


Fig. 5.23 Proprietary cavity closure at sill.

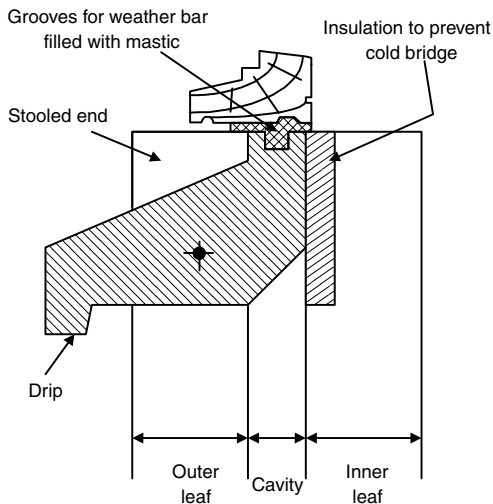


Fig. 5.24 Alternative sill in PCC.

Bullnose bricks can be laid on edge to provide a sill. The plain header end is cut to a bevel against the inner leaf and the bricks are canted up at the inside end to form a weathering. The sharp arris at the bullnose end forms a satisfactory drip. A strong mortar is required to provide a reasonably weather resistant joint. The detail is illustrated in

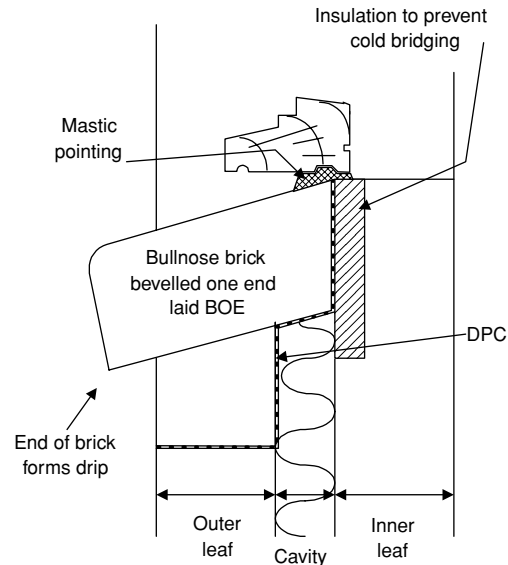


Fig. 5.26 Bullnose brick sill.

Figure 5.26. DPCs are best taken one full course below the bullnose sill.

Note that it is only on the PCC sill details that stooped ends are shown because only PCC (or stone) sills are built into the walls at the jambs. Tile and brick sills are built only between the jambs. PCC (and stone) sills are also made without stooped ends, to be built into the opening after the walls are complete and either just before or after the window frames are fixed. Such sills are termed 'slip sills'.

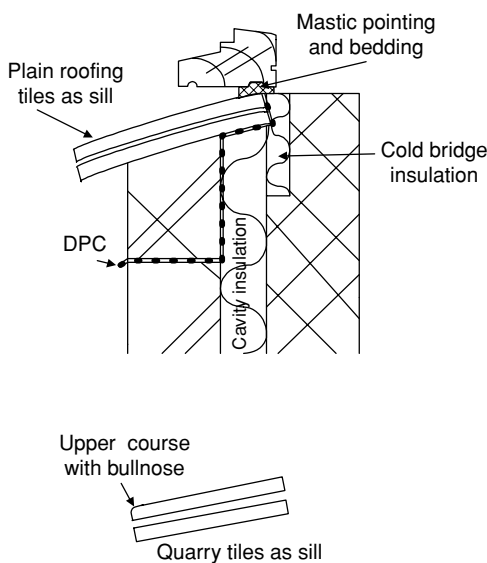


Fig. 5.25 Tile sills.

Threshold arrangements

What a sill is to a window, the threshold is to a door. The same requirements apply – the need to make this opening joint wind and watertight. Many variations are seen, but with frames recessed into openings, the ideal situation is to provide a step up to the floor level with the face of the step in the same plane as the face of the door. Figure 5.27 shows this detail and points out one possible weakness – the fixing of the weather bar. Figure 5.28 shows a solution to that problem which does not jeopardise the integrity of the detail but provides a secure anchorage for the weather bar. The

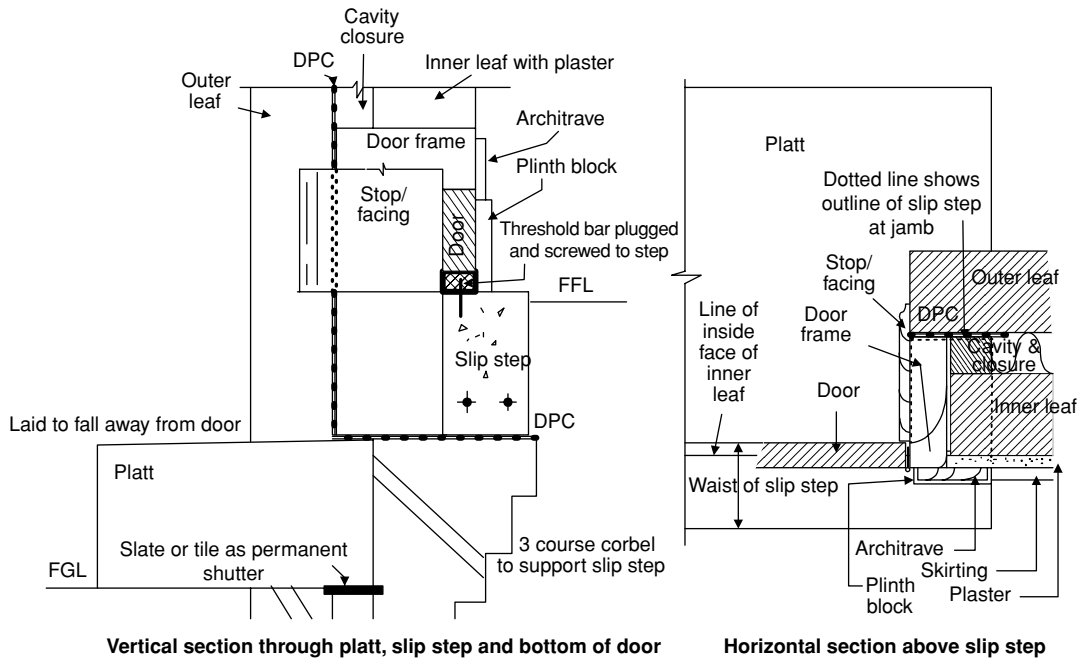


Fig. 5.27 Threshold (1).

detail is shown in Figure 5.29 and a photograph in Figure 5.30.

Note that the first detail, Figure 5.27, shows the traditional full width frame in the checked reveal while the second detail, Figure 5.29, shows a more modern small section frame

with the reveal finished in the same way as the wall. Note that the second arrangement reduces the amount of timber used for the door frame and the stop facing; there are no plinth blocks to make and fix and no architrave; there are $\frac{1}{4}$ round beads; and plaster and skirting

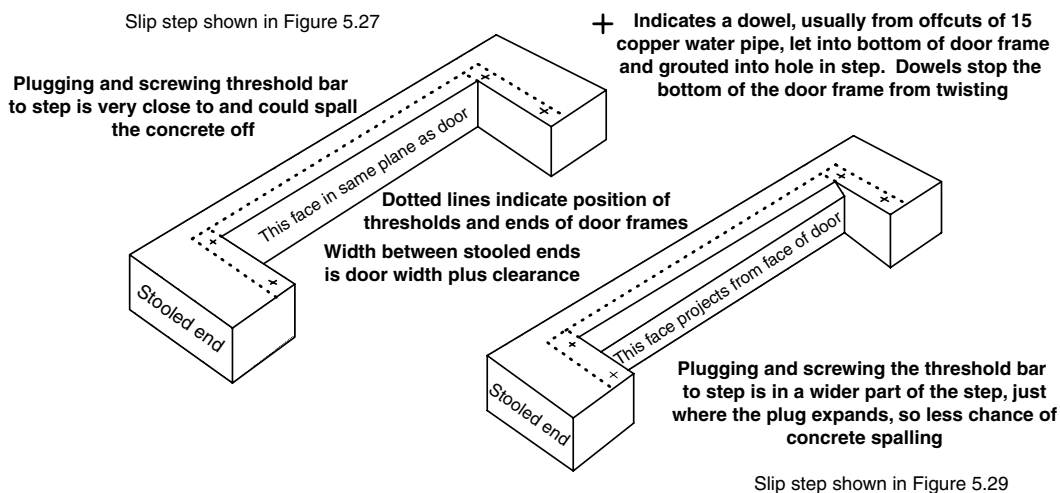


Fig. 5.28 Slip steps.

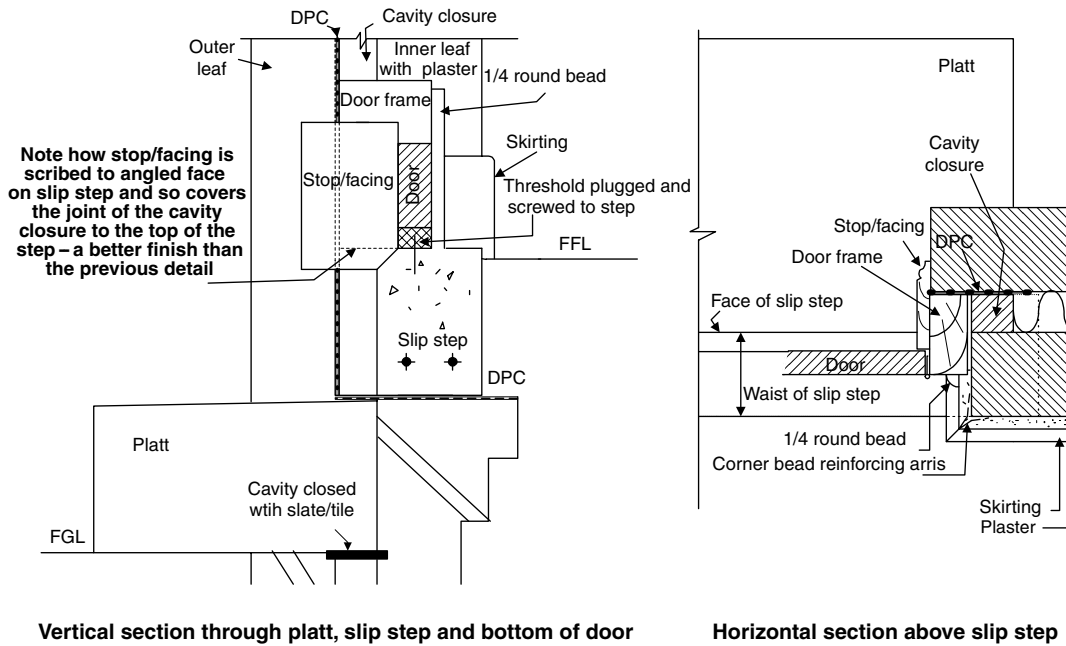


Fig. 5.29 Threshold (2).

have to return into the reveal from the wall face. This detail is more economical than the first arrangement.

Note that in both details the type of floor has not been shown. This is irrelevant to the threshold construction, although for some

floors the DPC under the slip step should be turned up between step and floor – very important if the floor is of hung timber or concrete construction. For solid concrete floors, the DPC should be joined to the DPM.

It is usual to keep the top of the slip step slightly higher than the finished floor level of the building. This allows for any thickness of floor finish put down by the occupiers such as carpet, vinyl sheet, etc.

Threshold bars come in a bewildering variety of types, sizes, materials and finishes. Some have moving parts (to be avoided, as they inevitably break down); others have fixed sections. Some have only one section fixed to the slip step; others have a number of sections fixed to both slip step and door.



Fig. 5.30 Photograph of threshold (2).

Partitions of masonry

The fitting of door frames into the openings in partitions can be done using full width or part width door frames. The effect is similar to that seen with the external doors shown earlier.

Figure 5.31 shows lintelling arrangements. Figure 5.32 shows two typical examples – a part width frame with a PCC lintel and a full width frame with a pressed steel lintel. The choice is deliberate as it is difficult to finish the soffit at a part width frame where there is a pressed steel lintel of this type – how is the finish attached to the corrugated shape of the lintel? It might be possible to introduce a strip of metal lath, but how can one conveniently fasten that to the lintel?

Frames for doors in partitions will normally include a timber threshold plate (not to be

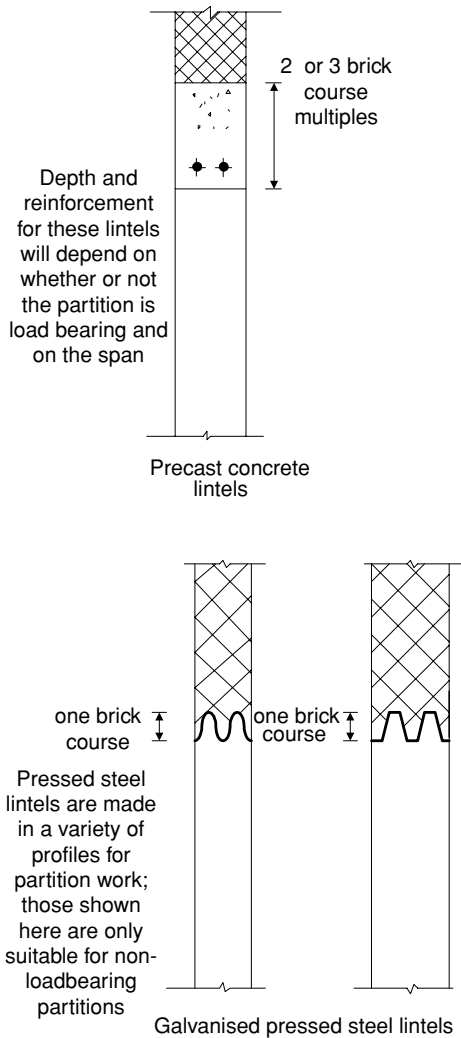


Fig. 5.31 Partition lintels.

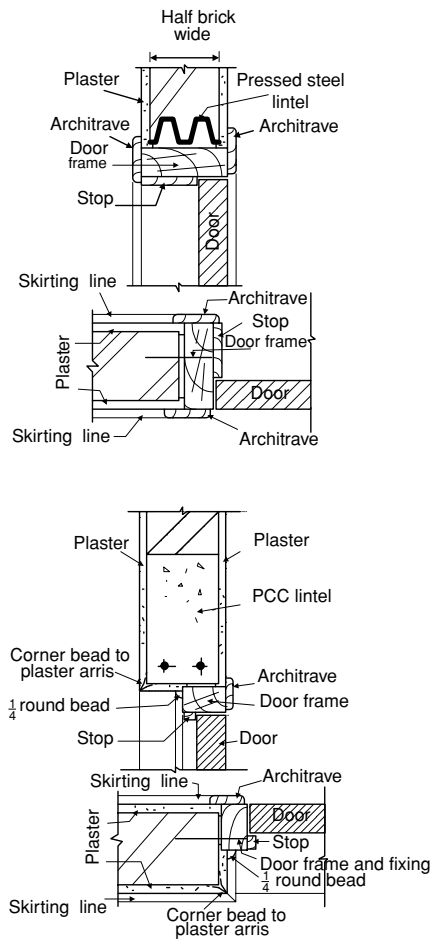


Fig. 5.32 Partition door openings.

confused with a threshold bar), a plain timber section, usually hardwood. This may be only the width of the door (irrespective of the actual frame width) or the width of the frame. From a purely practical point of view, a full width plate is best as any floor covering fitted to the threshold plate does not incur excessive waste. Indeed, the occupant may be forced to purchase the next width up in floor covering because of the door 'recess'.

For fastening frames, see Appendix G, particularly nailing to dooks and proprietary framing anchors. Note in the partial width frame situation how close the frame fastening is to the edge of the frame, or if it is set in the middle how close it would be to the edge of the wall.

In all the door frames fastened to masonry, 3 or 4 frame anchors or plugs should be used in internal walls and 4 or 5 for external doors, depending on the weight of the door leaf.

Openings in timber frame walls

Openings in timber frame walls share only three things in common with masonry walls:

- The need to provide support for the structure built over the opening
- The need to provide a finish to the structure below the opening
- The need to close cavities and maintain a waterproof interface with whatever the openings will accommodate.

Additional features include:

- The need to include fire stopping round openings
- Proper weather proofing where the outer skin is of the rain screen variety (this will be explained as we go along)
- Provision for differential movement at openings in structures over three storeys high between the frame and the facing material, particularly a facing of masonry. This will not be included in this text.

We begin by looking at suitable details for one- and two-storey buildings with domestic or light commercial loadings, in each case taking different cladding systems/techniques into account. As we have done before, we can classify the openings according to size:

- For small pipes and cables < 50 mm diameter
- For pipes and ventilators >50 mm diameter but <225 mm
- In excess of 225 mm – large openings.

Openings for pipes and cables up to 50 mm diameter can be treated in the same way, no matter what the storey height.

When cutting through a timber frame wall for a pipe or cable, the elements shown in Figure 5.33 will all be pierced and the cavity bridged; if not treated properly this will be

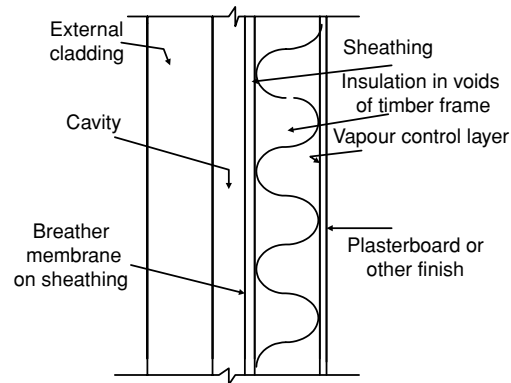


Fig. 5.33 Timber frame wall schematic.

a source of potential trouble as the building ages.

Starting at the inner face, the hole in the plasterboard can be disguised by using a floor plate. Immediately behind is the vapour control layer (VCL) which if badly torn will allow water vapour to collect in the insulation – a possible source of condensation and rot on the back of the sheathing. Cutting through the sheathing causes no problems but piercing the breather membrane could allow solid water to pass to the sheathing.

The breather membrane should be cut with an upside down T-shaped cut which forces any solid water to run round the cut and down the face of the membrane. This is illustrated in Figure 5.34. Bridging the cavity must be done

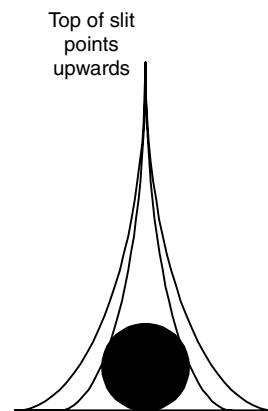


Fig. 5.34 Cutting waterproof fabric for pipe passing through.

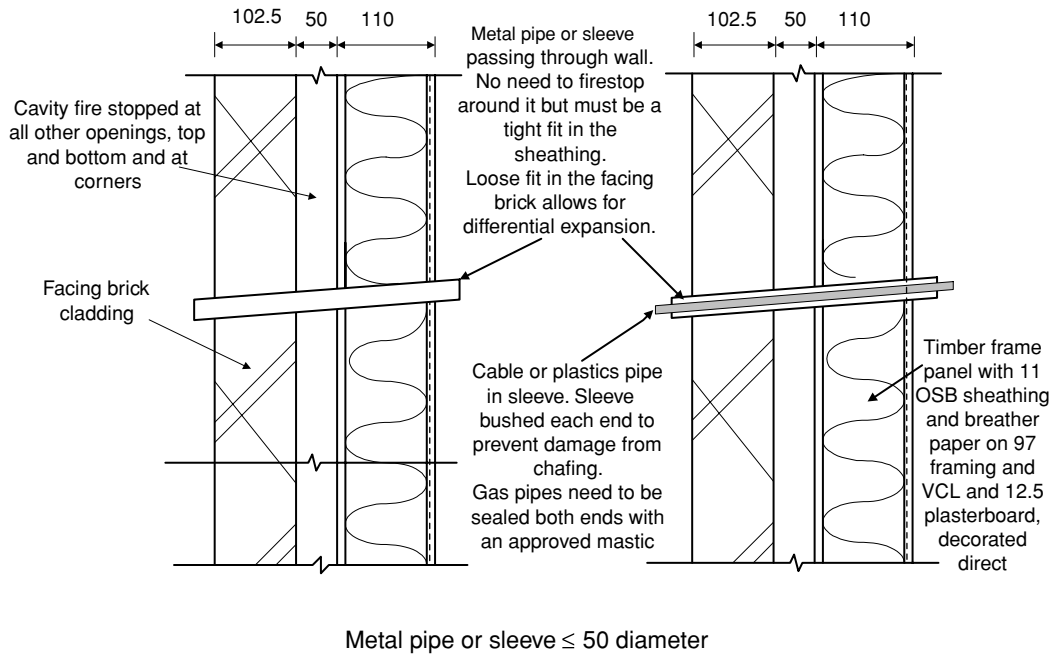


Fig. 5.35 Pipes and ducts through timber frame wall (1).

with any material sloping down towards the cladding, thus preventing solid water reaching the breather membrane. Cutting through the outer cladding must be done with care, not only from the point of view of appearance but also to keep the hole to the minimum required, so preventing vermin and larger insects getting into the cavity. Larger holes will also allow weather, particularly rain and wind-driven snow to penetrate. This is more important where the external cladding is of the rain screen variety.

Commencing with a masonry layer, Figures 5.35 and 5.36 show some typical examples; the slope to the outside is, of course, exaggerated. In Figure 5.36 a duct is illustrated which could be circular or rectangular, plastic or metal. Whichever of these combinations it is, there is every need for fire stopping around it. Sealing of all the ducts, sleeves and pipes to the masonry cladding could be done, but rather than using the ubiquitous silicone sealer, one based on polysulphide might prove to be more long lasting. There is nothing wrong with silicone sealers but frequently the incorrect grade is used and often in the wrong places for a silicone-based product.

The examples shown have only illustrated a cladding of masonry which to some degree or other will absorb rain driven onto its face. Penetration to the cavity is not a problem as measures are built into the general detailing to cope with this, particularly the provision of a DPC layer between fire stopping and cladding.

Rain screen cladding

Mention was made earlier of rain screen cladding. These types of cladding do not absorb water to any great extent and some not at all:

- Slightly absorbent claddings include slate and tile, both clay and concrete, timber such as shiplap or weather boarding, and boards made from timber, asbestos cement or silica fibre cement compounds.
- Non-absorbent claddings include metals and glass.

Metals and glass are seldom used in domestic structures in the UK but are common in North America, as are boards of timber fibre and asbestos cement. This leaves tile or slate

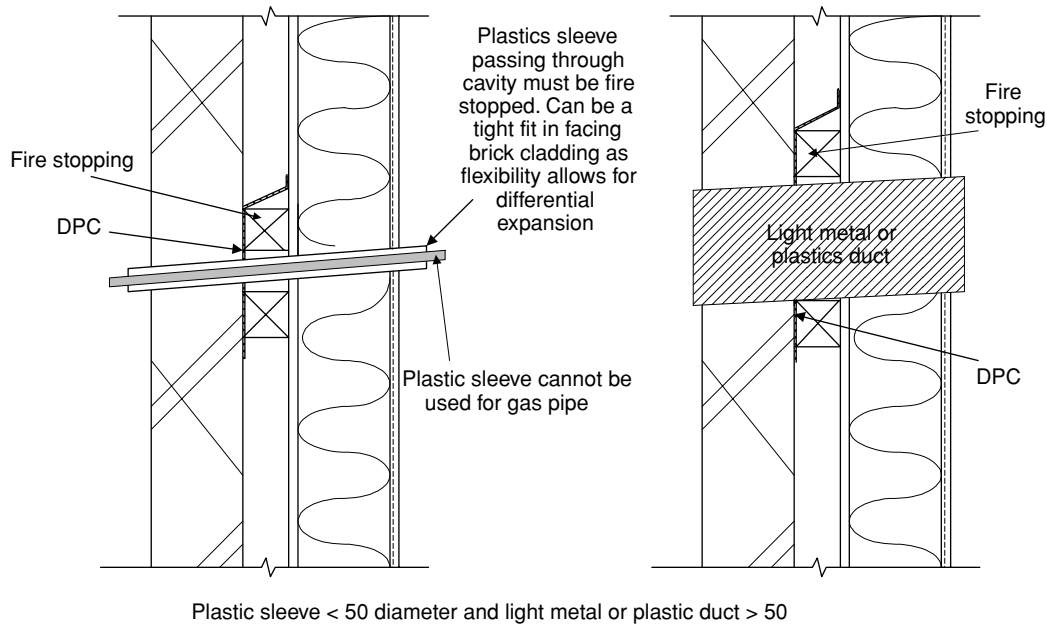


Fig. 5.36 Pipes and ducts through timber frame wall (2).

cladding and timber weather board or shiplap cladding. All are quite common.

Vertical slating and tile hanging is usually done on horizontal battens nailed to vertical battens which in turn are fixed through the breather paper and sheathing to the studding of the timber frame. The vertical battens allow a space to be formed from top to bottom of the wall cladding, and this should be finished off top and bottom to allow a free air flow, thus allowing any water getting past the tiles onto the breather membrane to dry out.

Timber boarding is normally fixed horizontally to vertical battens which in turn are fixed through the breather paper and sheathing to the studding of the timber frame. Shiplap boarding is always fixed horizontally but weatherboarding can be fixed diagonally, although this is only done for decorative effect. Any attempt to have timber boarding fixed vertically should be avoided as it defeats the rain screening properties of the boards.

Figures 5.37 and 5.38 show the same pipe, sleeve and duct situations already examined for a masonry cladding. Here the cladding has changed to tile, weatherboarding and shiplap boarding.

Permutations of various finishes showing small pipe, sleeves or ducts through all the various combinations of cladding for timber frame construction would be excessively repetitive here. The details already covered can be extrapolated to cover most situations.

Lintels

Large openings are those which require support provided by lintelling over doors and windows, and here techniques have similarities to masonry construction:

- The opening in the timber frame is spanned by a lintel – in this case made from timber or a timber/steel combination.
- The jambs provide support for the lintel by the insertion of additional studs called **cripple studs**.
- There can be multiple cripple studs in one jamb, some supporting the lintelling arrangements and others supporting a sill.
- The bottom of the opening is finished off with a sill or a threshold

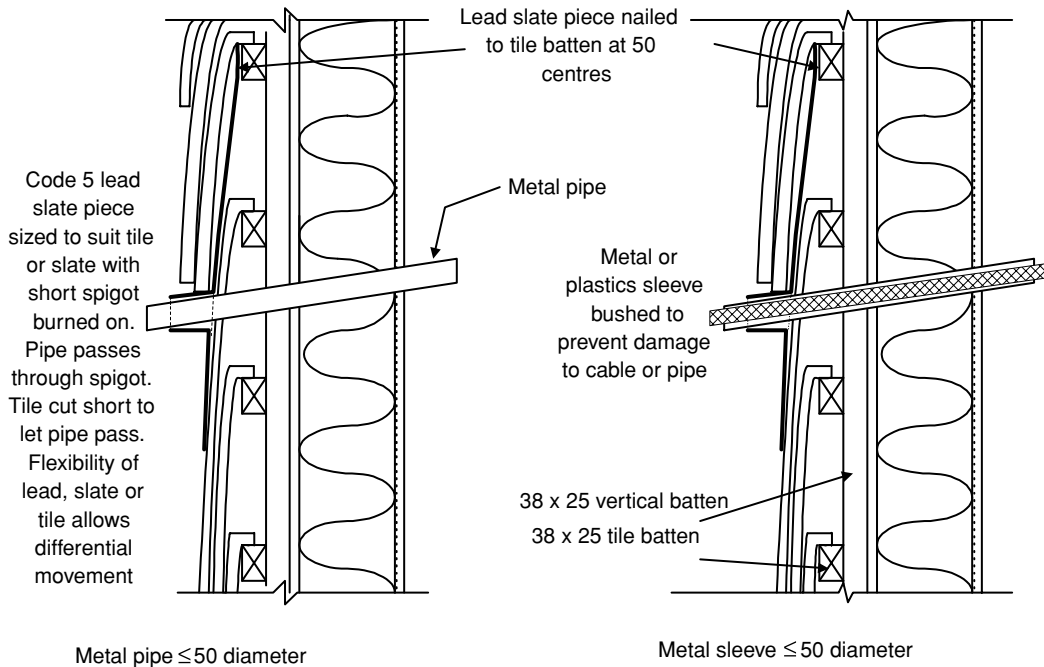


Fig. 5.37 Pipes and ducts through timber frame wall (3).

- Sills require support from cripple studs.
- Masonry claddings require support over the opening and this can be done with conventional lintels of concrete or steel or by special steel lintels restrained against the timber frame
- Jambes are treated conventionally externally and internally but the structure within the

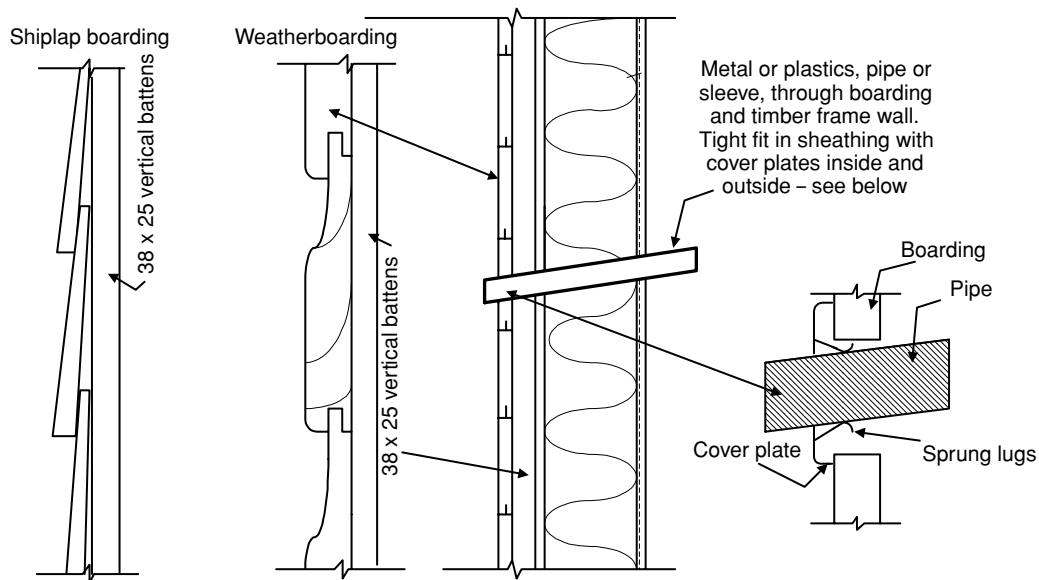


Fig. 5.38 Pipes and ducts through timber frame wall (4).



Fig. 5.41 Modern timber panel at window opening.

the inside of a timber frame panel but note the OSB skin, the regularised and stress graded timbers, the timber lintel supported on double cripple studs and the narrow sill support on cripple studs. Now compare with Figure 5.40. The studs, runners and dwangs are regularised and 97×47 but the studs are put in



Fig. 5.42 Rolled steel channel as lintel in timber panel.

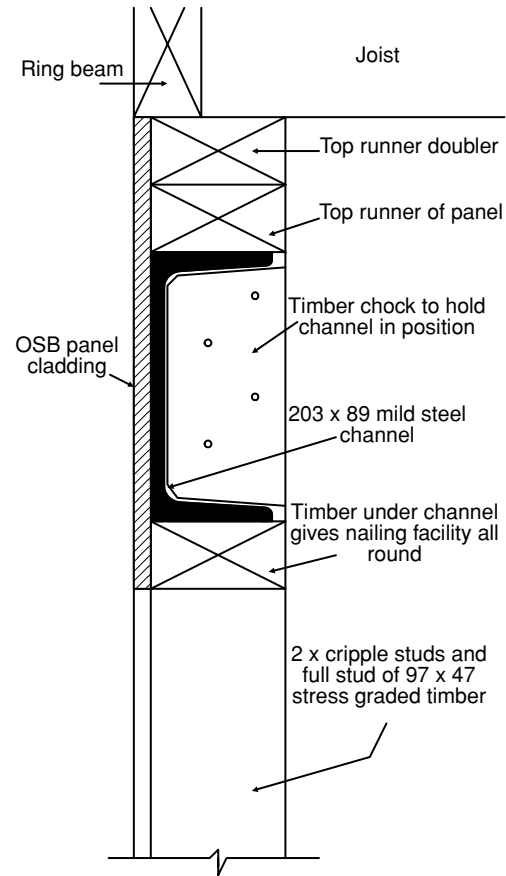


Fig. 5.43 Detail of rolled steel channel as lintel in timber panel.

at 600 centres and so the joists are put in at 600 centres and have to be much deeper. A further complication is the need to keep ceiling heights down. If wooden lintelling is used for wide openings, the top of the glass in the window would be much too low. This can be



Fig. 5.44 Flitched beam over large opening.



Fig. 5.45 Flitched portal frame round opening in timber panel.

solved in one of two ways depending on the loadings involved.

The first way is shown in Figure 5.42 and uses a combination of a mild steel channel sandwiched between two layers of the 97×47 timbers, with blocks at each end set into the channel and nailed to the studs. These keep the channel in position. Note that there are doubled cripple studs supporting each end of the channel/timber lintel. Channel irons are made in a range of sizes but any in the range 76×38 to 305×89 would be suitable. Figure 5.43 shows a detail at the head of the frame.

The second way is to 'flitch' the frame members—both studs and lintels—to make a 'portal' round a large opening such as a patio door. Figure 5.44 is a photograph of a flitched beam spanning a wide opening and is followed by a photograph of a flitched portal frame in Figure 5.45. The steel strip in the portal frame was welded at the corners before sandwiching it and bolting up between the timbers. Note that the steel does not extend to the bottom of the jambs but stops short. A plywood packer is put between the timbers.