6.2.3 Structural design requirements

Load bearing timber frame elements shall meet the requirements of relevant standards and the Building Regulations, be durable and safely support and transmit the intended loads to the foundations without undue movement.

The following should be taken into account:

- Structural design
- Timber specification
- Preservative treatment
- Moisture content

Structural design

Timber frame panels should be designed in accordance with Eurocode 5, in particular BS EN 1995-1-1. Wind, roof, floor and cladding loads should be taken into account as a part of the overall design. The structural design should also take account of any loadings from external attachments (such as balconies).

Please note, designers should not mix and match codes or standards.

Timber specification

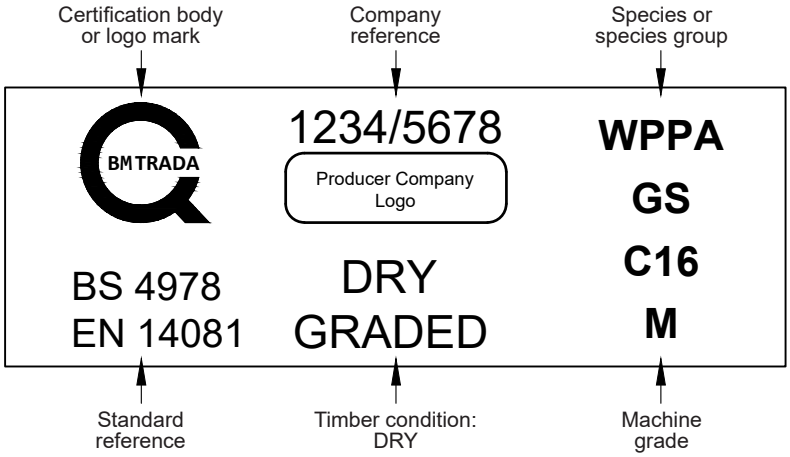
BS EN 338 should be used by the designer to determine the suitable strength class for structural timber components.

All structural timber should be:

- Machine graded to BS EN 14081 or, visually graded to BS 4978 for softwoods or BS 5756 for hardwoods.
- Dry graded.
- Marked in accordance with BS EN 14081.

All load-bearing solid timber studs, rails, binders and sole plates should be of a minimum dry graded C16.

Typical grading stamp



Oak

The guidance within this section is primarily for conventional timber frame open panel systems made off-site under factory Conditions. Oak used as a structural element and bespoke one off oak frame buildings will not be acceptable to us. See ‘Appendix C’ for further details.

Preservative treatment

All load-bearing timber components shall be either naturally durable or preservative treated in accordance with BS 8417: Preservation of wood code of practice. Sole plates and load-bearing timber studwork are considered to be in ‘Use Class 2’. Sole plates are normally considered to be included in ‘Service Factor Code C’, while load-bearing timber studwork is included in ‘Service Factor Code B’. For Warranty purposes, service factor code B is always required.

All structural timber should be treated with a preservative suitable for the ‘Use Class’ and ‘Service Factor’ applicable to its use.

Where treated timber is cut, the exposed end will not be protected by the original preservative treatment. When treated timbers are cut in the factory or on site, the cut ends shall be re-treated with a preservative compatible with the original treatment used, this treatment should be coloured to allow easy checking on site.

Moisture content

All structural timber components should be at a moisture content of 20% or less at the time of manufacture. Once panels are manufactured, they should either be stored in a covered storage area, or loosely covered with a water proof sheet material. Confirmed as square by sample checking for equal diagonal measurements, lengths and heights.

6.2.4 Quality assurance systems for open timber frame panels

All timber frame Designers, Manufacturers, and Erectors shall possess evidence of compliance from at least one of the following quality assurance schemes:

- Full system acceptance and factory inspection by the Innovations team.
- The BM TRADA Q-Mark Timber Frame Elements Certification Scheme.
- Gold or silver members of the Structural Timber Association.
- CATG - Frame Mark.
- Other relevant third party quality assurance scheme that is acceptable to us.

The level of membership may need to be clarified as some levels may not meet the above requirements.

Where no evidence of quality assurance systems/bespoke site assembled timber frame is present

Where evidence of an appropriate quality assurance system cannot be provided or for bespoke site assembled timber frame, the following should be satisfied (max 5 per project):

- Provide full structural design calculations for each house type, confirming the design meets BS EN 1995-1-1. This must include fixing details for any non timber components.
- Ensure an independent Engineer (not the design Engineer) monitors the design, installation, erection and completion of the timber frame system and provide a sign off statement at completion of the waterproof shell confirming that the timber frame construction has been installed as per the design.
- Satisfy the Warranty surveyor that the materials/products used are suitable and meet the requirements of the Technical Manual (e.g. timber specification and treatment, tolerances, drained and ventilated cavity, etc.).

6.2.5 Manufacturing tolerances

Timber frame panels shall be manufactured within the tolerances outlined in the guidance.

The following are our manufacturing tolerances that timber frame manufacturers' must adhere to:

- Length: +/-3mm.
- Height: +/-2mm.
- Diagonals should be equal, acceptable deviation is +/-5mm.
- Opening dimensions: 0mm, +5mm.

6.2.6 Timber frame delivery and storage on-site

Timber frame panels shall be delivered and stored on-site so that the durability or service life is not impaired.

Timber frame components should be:

- Carefully unloaded to avoid damage or distortion of components.
- Stored off the ground on an adequate number of level bearers.
- Loosely covered with a waterproof membrane to allow protection from moisture while allowing ventilation if they are not to be used for a prolonged period.
- Unwrapped if tightly bound in polythene and loosely recovered with a waterproof membrane to allow ventilation.
- All structural timber components should be at a moisture content of 20% or less at the time of manufacture. Once panels are manufactured, they should either be stored in a covered storage area, or loosely covered with a water proof sheet material. Confirmed as square by sample checking for equal diagonal measurements, lengths and heights.
- Handled and stored with particular consideration to moisture damage where insulation and VCL are incorporated.

6.2.7 Site preparation

The substructure shall be correctly set out to receive the timber frame.

Pre-commencement

To allow the building to be constructed as designed all necessary drawings, specifications and fixing schedules shall be provided to site before work commences.

Foundations

It is important that the tight tolerances for timber frame are understood, getting the location and level of the foundation correct is one of the most important parts of the build process.

The foundations or upstands that support the timber frame should be set out to the dimensions noted on the timber frame drawings:

- Within +/-10mm in length, width and line.
- Diagonals should be within +/-5mm up to 10m, and +/-10mm more than 10m.
- Levelled to +/-5mm from datum.

6.2.8 Timber frame erection tolerances

Timber frame wall panels shall be erected to the tolerances outlined within the guidance.

Wall panels should be erected to the following tolerances:

- +/-10mm from plumb per storey height.
- +/-10mm from plumb over the full height of the building.
- +/-3mm from line of sole plate, with maximum +/-5mm deviation from drawing.
- +/-5mm from line at mid height of wall panel.
- Inside faces of adjacent wall panels should be flush.
- Adjacent wall panels should be tightly butted.

6.2.9 Timber frame and external ground levels

Timber frame construction shall be erected so they are at least 150mm above external ground levels.

Timber frame systems should be erected on a DPC at least 150mm above external ground level. Where cavity trays are included in any detailing, there shall be consideration for drainage and ventilation requirements of the timber frame system.

Where cavity tray detailing is proposed, ventilation must be provided above and below the cavity tray in order to provide:

a. Drainage and ventilation to the timber frame cavity above the cavity tray, **and**
b. Ventilation to the sole plate below the cavity tray.

Where flexible DPC materials are to be used as a cavity tray, they should have supporting evidence in the form of a Declaration of Performance to BS EN 14909:2012. They should also have a third party product conformity certificate confirming their suitability for use as a cavity tray.

6.2.10 Gas protection system

Where a gas protection system is required (e.g. gas membranes) it shall:

- Be specified in accordance with relevant standards.
- Not impede on the drainage and ventilation requirements of the timber frame system.
- Be installed to manufacturers recommendations.

Where a gas barrier is required it should be specified and installed by suitably qualified persons.

Please refer to the ‘Ground Conditions – Managing Ground Contaminants’ section for further guidance.

6.2.11 Sole plates

Sole plates shall be durable and safely transfer loads from the superstructure to the substructure and provide a level base for erecting the timber frame wall panels. The following shall be taken into account:

- Location. Sole plates must be located 150mm above external ground levels.
- Damp proof courses.
- Fixings.
- Ventilation.
- Packing.

Location

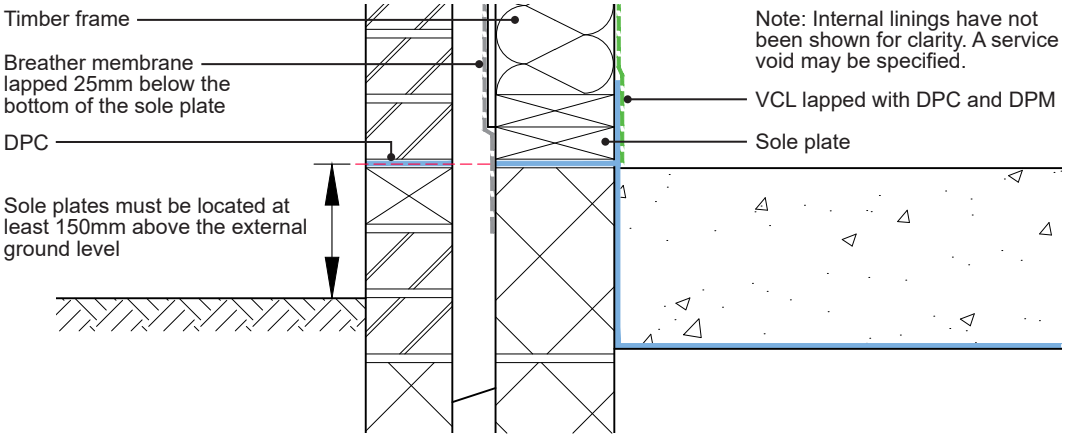
Sole plates must:

- Be located so that all structural timber is at least 150mm above external ground level. The use of a masonry foundation kerb upstand may be an appropriate method to achieve this. The exception to this is for localised ramping incorporating satisfactory drainage and ventilation detailing for level threshold requirements.
- Be levelled to +/-5mm from datum.
- Not overhang or be set back from the substructure by more than 12mm on a 89mm sole plate and 20mm for a 140mm sole plate. Ledges formed by the frame being set back from the supporting base should be protected from moisture by a membrane.

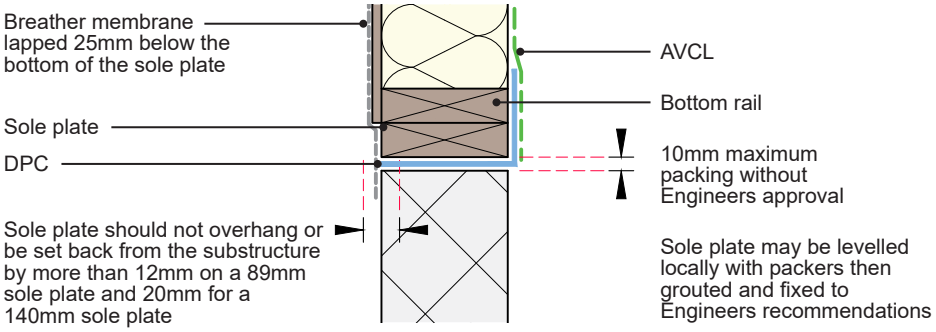
- Be set out within +/-10mm in length and in line within +/-5mm, as defined by the timber frame drawings.
- Diagonals should be within +/-5mm up to 10m, and +/-10, for more than 10m.

Notes:
- Internal and party wall timber sole plates should not be installed below internal finished floor level.
- Localised level access provision should follow guidance in the 'Driveways and Paving' section. Infinity patio type scenarios are not acceptable for Warranty unless suitable drainage provision acceptable to us is provided between the external wall and the ground finishes.
- Where the soleplate overhangs and a masonry outer leaf is specified, a 50mm cavity must always be maintained.

Sole plate/foundation junctions



Locating sole plates



Damp Proof Course (DPC)

A DPC should:

- Be located directly below all timber sole plates.
- Any junction formed in the DPC should overlap by at least 100mm.
- Be located flush to the outside edge of the sole plate.
- Provide 100mm lap to any AVCL provided within the wall panel.

Fixings

Fixings should:

- Be installed to the Engineers specification.
- Not damage the substructure or sole plates during installation.
- Be placed to provide adequate lateral restraint at door openings.
- Be specified with consideration for use with gas membranes where appropriate.
- Sole plates should be fixed to foundations with shot fired nails, proprietary sole plate fixings, anchors, brackets, or straps, as specified by an Engineer.
- If holding down straps are used, they should be stainless steel grade 1.4301 steel to BS EN 10088.

Ventilation to sole plate area

Regardless of the cladding system used, a cavity with provision for drainage and ventilation should be provided between the cladding and the timber frame ensuring that adequate ventilation provision is provided to all areas of the timber frame including the sole plate.

Packing

Structural shims or grout may be required under sole plates to level them and transfer vertical load. Longer fixings may be needed to allow for the size of the gap.

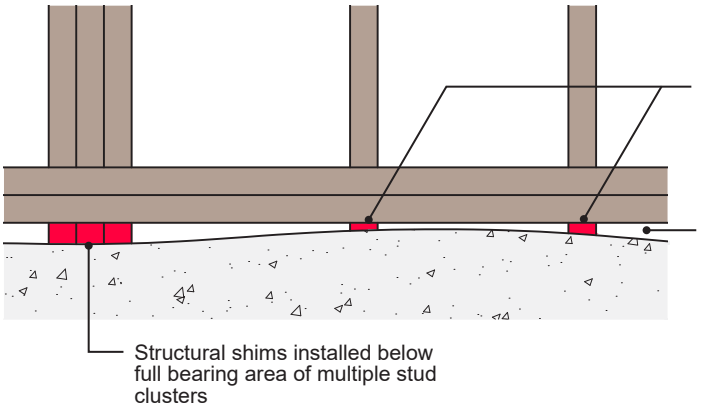
Structural shims

Structural shims should be position below all timber studs and be of the same cross section. Lightweight window packers should not be used.

Structural grout

Structural grout should be as per an Engineers specification. The use of structural grout is not considered suitable for gaps less than 10mm due to installation difficulties. Where grout is used as permanent structural packing, installation should be checked to ensure full bearing is achieved.

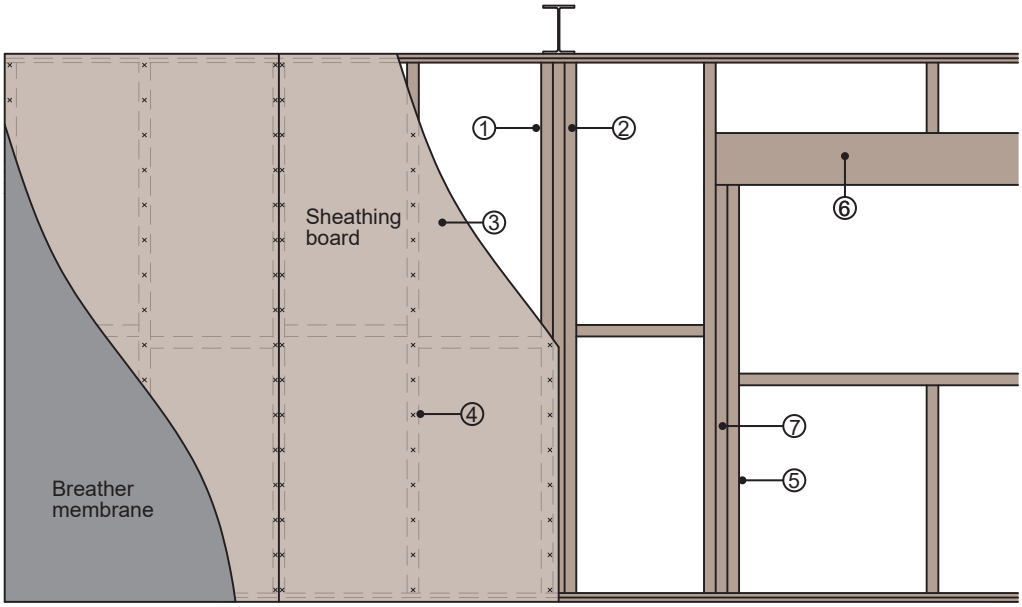
Packing of sole plates



6.2.12 Timber frame wall panels

Timber frame external wall panels shall:

- Be manufactured and fixed in accordance with the Engineer's design and specification.
- Consist of solid timber studs and rails.
- Have studs at a maximum of 600mm centres and a minimum width of 37mm
- Be braced with a structural sheathing board.



1. Machine graded to BS EN 14081 or, visually graded to BS 4978 for softwoods or BS 5756 for hardwoods. All load-bearing solid timber studs, rails, binders and sole plates should be of a minimum dry graded C16.
2. Any point load imparted onto the timber frame should be transferred down through the building to the foundations with the use of multiple studs, as required by the Engineers design. If these are not installed during the manufacture of the panels the requirement for installation must be clearly conveyed to site.
3. Wood-based board materials used for sheathing should be fixed to the studwork frame leaving a 3mm minimum gap between boards to allow for moisture-related movement.
4. The fixings securing the structural sheathing board to the timber studwork wall panels provide racking resistance as calculated by the Engineer. The sheathing board shall be fixed to the timber studwork in strict accordance with the Engineer's fixing schedule. Fixing centres should not exceed 150mm around the perimeter of the board and 300mm centres in the field of the board. Sheathing fixings must not be over-driven through the face of the sheathing board.
5. Studs should be provided around window and door openings and adjacent to movement joints to allow the installation of wall ties or other cladding fixings. They should be accurately cut to length and bear tightly against the wall panel top and bottom rails.
6. A lintel may be required where openings do not fall between studs unless the vertical load is adequately transferred by other elements.
7. Lintels will require support of cripple studs. All structural timber should be treated with a preservative suitable for the 'Use Class' and 'Service Factor' applicable to its use.

Lintels and openings

Timber lintels should be provided within timber frame panel over openings. They should safely support the applied loads, be of the correct size, and have adequate bearing.

Openings in timber frame panels should have timber lintels which are supported off of cripple studs except where:

- The stud spacing is not affected by the opening, **or**
- Supported loads are carried by a ring beam or header joist.

For guidance on steel and concrete lintel provision in external masonry cladding, please refer to the 'External walls – External Masonry Walls' section.

Fixings and junctions

All fixings are to be installed to the Engineer's specification, unless otherwise justified:

- Junctions of wall panels and sole plates/head binders should not occur together.
- Head binder laps should wherever possible occur over a stud, preferably at least 600mm from the panel junction.
- Wall panel to wall panel connections should be a maximum of 300mm centres.
- Bottom rail to sole plate fixings should be one or two per stud bay.
- Wall panels should be adequately braced during erection to maintain tolerances.
- Disproportionate collapse components and fixings must be installed if specified.
- Multiple stud clusters which are considered structural (e.g. point load-bearings) should be designed by an Engineer.
- Point loads must be transferred down through wall panels and floor zones to foundations.
- Engineered timber components should not be exposed to moisture for longer periods than those stated by the manufacturer.
- Roof trusses/rafters should be adequately fixed to wall panels.
- Floor joists should be nailed down to wall panels.
- If no head binder is present, floor joists must bear directly over studs.
- Waistbands and alignment of floors over walls should remain within tolerances for wall panels.

Timber framing components and structural sheathing boards may be fixed with either nails or staples.

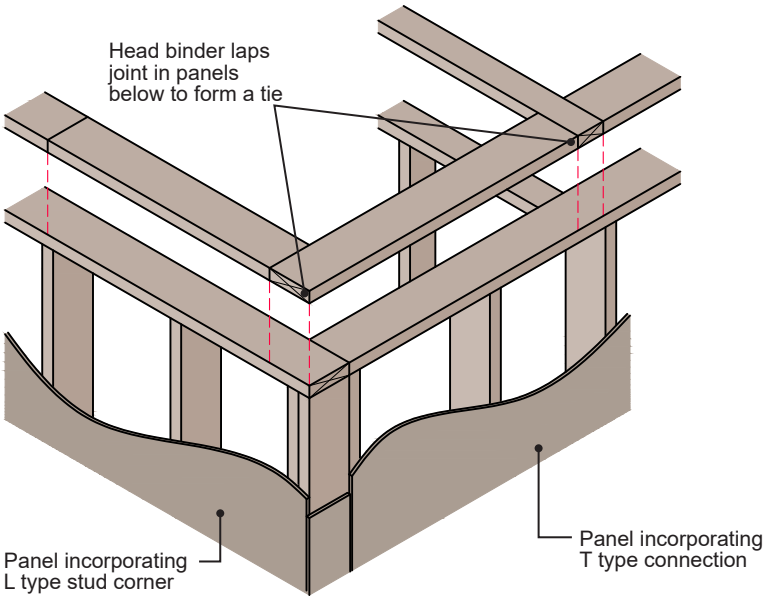
Nail fixings should be either:

- Austenitic stainless steel, **or**
- Galvanised, **or**
- Sherardized.

Staple fixings should be austenitic stainless steel or other material of similar strength and corrosion resistance.

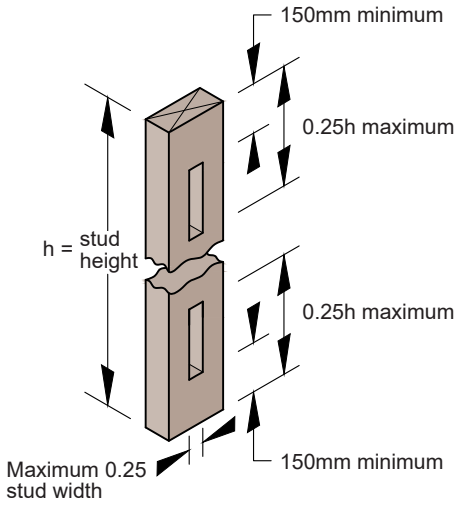
Head binder lapping

- Head binder butt jointed over stud or lintel which is fixed to the underside of the top rail.
- Head binder nailed to frames. Fixings determined by timber frame engineer's calculations.



Drilling of studs

Drilling on centre line only. Hole diameters should not be greater than 0.25 the stud width and hole centres should not be closer than 4d (d = hole diameter).



6.2.13 Structural sheathing boards

Structural sheathing boards shall be of a suitable strength and durability and be specified by the Engineer to provide racking resistance to the structure.

Materials

Structural sheathing board materials may be any of the following:

- Orientated strand board (OSB). OSB should be grade 3 or 4 in accordance with BS EN 300.
- Plywood. Plywood should be at least Class 2 or 3 Structural in accordance with BS EN 636.
- Impregnated soft board. Type SB.HLS in accordance with BS EN 622-4.
- Non timber based boards or other board material must have a suitable third party product conformity certificate which is acceptable to us.

All wood-based panel products should comply with BS EN 13986: Wood-based panels for use in construction characteristics, evaluation of conformity and marking.

Please note:

- We do not accept the use of MgO boards.
- The selection of materials for the structural sheathing boards should satisfy the relevant Building Regulations in respect to fire safety.

Fixings

The sheathing board shall be fixed to the timber studwork in strict accordance with the Engineer's fixing schedule. Fixing centres should not exceed 150mm around the perimeter of the board and 300mm centres in the field of the board. Sheathing fixings must not be over-driven through the face of the sheathing board.

6.2.14 Breather membranes

Breather membranes shall be installed to protect the timber frame system and sheathing board from moisture whilst allowing water vapour from within the frame to pass into the cavity. The following shall be taken into account:

- Specification of the membrane
- Positioning
- Lapping
- Fixing
- Exposure of the breather membrane

Specification

Breather membranes should:

- Have an appropriate third party product conformity certificate.
- Have a vapour resistant to less than 0.6MNs/g (0.12 Sd) when tested in accordance with BS EN ISO 12572 using the set of conditions C and using five test specimens.
- Be a minimum Class W2 or better in accordance with BS EN 13859-2.

- Be a minimum Class W1 in areas of very severe exposure, where liquid water penetration of the cladding is anticipated or where the membrane is likely to be left exposed during construction.
- Be UV resistant in accordance with BS EN 13859-2 where the cladding does not exclude UV exposure (e.g. such as open jointed cladding panels).
- Be capable of resisting water penetration.
- Be durable to resist site damage when wet.
- Be self-extinguishing.
- Be securely fixed to protect the outside face of the timber frame structure with austenitic stainless steel staples.
- Be trimmed to leave 25mm lap below the lowest timber sole plate.
- Be repaired if damaged.
- Have the location of solid timber studs clearly marked on the outer face of the breather membrane to ensure that cladding fixings are installed into solid timber.

Positioning

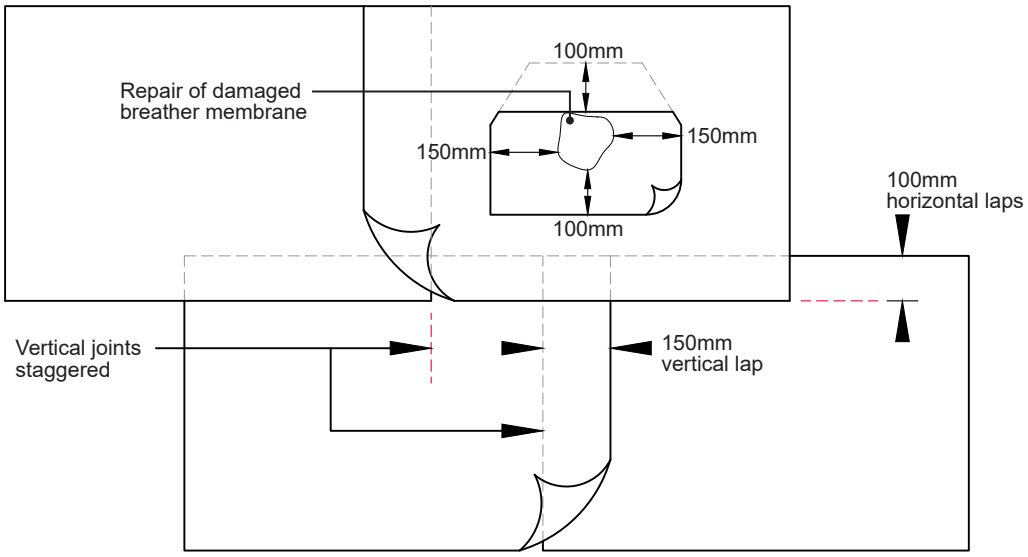
Breather membranes must be placed on the external face of the sheathing board to help provide weather protection to the sheathing board and the structural frame during construction. Any penetrations such as bracketry or fixings should be appropriately sealed as per the membrane manufacturer's instructions.

A breather membrane may also be required on the external face of the insulation which is in the cavity zone where required by the insulation manufacturer or third party product conformity certificate and subject to a condensation risk analysis.

A breather membrane must always be installed irrespective of the external sheathing board product.

Lapping

Breather membranes should be lapped by a minimum of 100mm at horizontal joints, and a minimum of 150mm at vertical joints. Vertical joints should be staggered at regular intervals where possible. The breather membrane should be lapped to deflect moisture away from the timber frame structure (upper layers over lower layers).



Fixing

Breather membranes should be fixed using austenitic stainless-steel staple nails at the following centres:

- Horizontal
  - Panel centres – 600mm max
  - Horizontal membrane joint - 150mm
  - Head and base of panels – 150mm
- Vertical
  - 300mm centres vertically (may be increased to a maximum of 500mm when verified with a third party product conformity certificate).
  - Vertical membrane joint – 150mm
  - Ends of panel – 150mm
- Around openings – 150mm

If breather membranes are trimmed flush with the edges of wall panels, additional strips of breather membrane, at least 300mm wide, should be supplied and site fixed over panel junctions.

Exposure of the breather membrane

In situations where open jointed claddings are used, **and/or** the breather membrane is left exposed during construction for a duration which exceeds what the manufacturer recommends (or what the third party product conformity certificate for the breather membrane states):

- The performance of the breather membrane should be based on artificial aged behaviour in accordance with BS EN 13859-2.
- A ventilated tarpaulin (or similar protective sheeting) should be used where there is an expected period of heavy rainfall followed by freeze thaw conditions.
- Where the cladding is not open-jointed (render board, brick cladding etc.) performance should be based on artificial aged behaviour in accordance with BS EN 13111.

6.2.15 Thermal insulation

Thermal insulation shall be specified correctly and installed to avoid damp, interstitial condensation and thermal bridging issues occurring within the wall makeup. The overall insulation value of the wall shall meet the requirements of relevant Building Regulations. The following should be taken into account:

- Specification
- Location
- Thermal bridging

Specification

Insulation materials should be chosen with consideration for their breathability and interaction with the timber frame and should have an appropriate third party product conformity certificate.

External walls should be subject to U-Value and condensation risk calculations. A wall build up will be considered satisfactory if there is no calculated risk of surface or interstitial condensation at any time of the year, and it fulfils the minimum national requirement for thermal performance.

Special consideration should be given to condensation risk where non-breathable insulation products are installed on the outside of the timber frame structure. Joints between foil faced external insulation boards, must not be taped as this forms a vapour control layer on the cold side of the insulation.

Depending on the specification of insulation materials to be added to the structural frame, timber battens may be required to support the insulation or allow fixing of plasterboard linings, or external cladding to achieve the specified period of fire resistance.

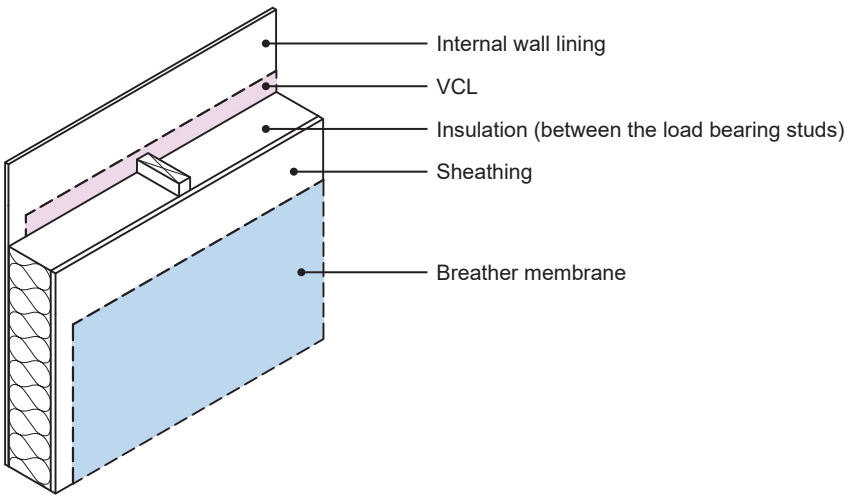
Locations

Insulation may be specified in any or all of the following locations:

- Between studs.
- On the inside of the timber frame.
- On the outside of the timber frame.

The following images do not show the external wall cavity or cladding for clarity.

Insulation between studs



Insulation which is placed within the stud void must cover the whole wall area between the studs with no gaps present at:

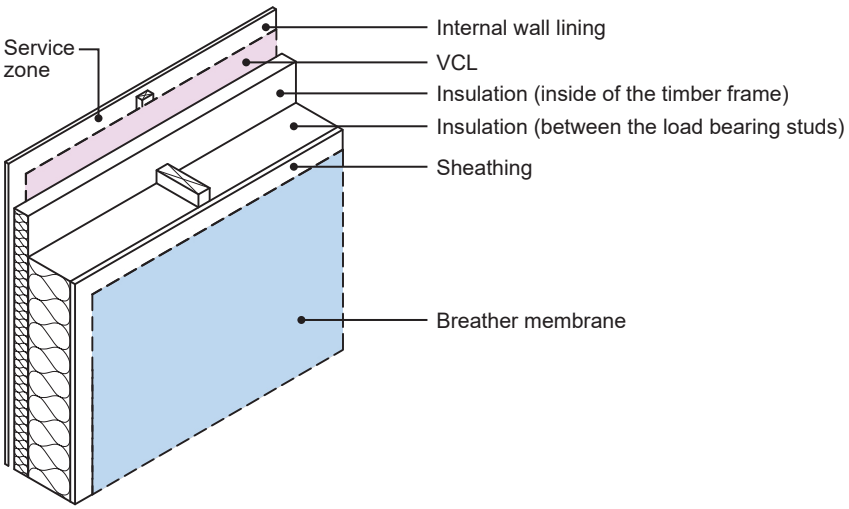
- Corners.
- At junctions with partitions.
- Against studs, rails or noggings.
- Behind services and pattress panels.

If insulation is specified between external walls studs all voids shall be filled with insulation to maintain the thermal envelope of the building. When noggins or boards are installed between studs to support services or heavy fittings the void behind them shall be fully insulated.

Insulation should not be installed until the structural timber frame is below 20% moisture content and the building is weather tight, as wet insulation can retain moisture. If closed panel timber frame is specified, additional care must be taken to protect the panels from exposure to moisture during construction, with moisture content checks carried out before full closure.

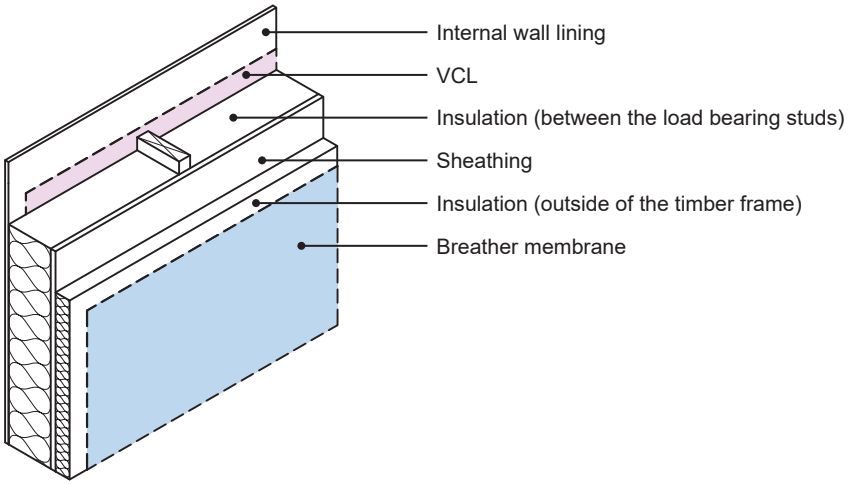
Note: The above also applies equally to insulated party wall cavities. There needs to be consideration for how party wall insulation is to be kept dry during the build process.

Continuous internal insulation



Please note: we cannot accept the above build up without appropriate fire test reports confirming its suitability.

Continuous external insulation



Insulation boards placed within the cavity space between the timber frame and external cladding shall also satisfy the following:

- Allowance should be made for differential movement to occur at floor zones.
- It should not retain or transmit moisture to cause the timber structure to exceed 20% moisture content.
- Stud locator marks should be transferred onto the outer face of the breather membrane adjacent to the external wall cavity.
- Wall ties should transfer loads to the timber frame structure. To achieve this, wall ties will typically need to be installed through the external insulation rather than bearing onto it.
- Where wall tie systems incorporate a vertical rail system:
  - The cavity insulation should be suitable for use with these systems.
  - The positioning the rails should ensure the fixings go back to the timber studs.
- Foil faced insulation boards should not be taped.

Thermal bridging

Insulation should be continuous at all junctions and all voids within the wall panel should be insulated to ensure thermal continuity is maintained and any small gaps which cannot be insulated effectively should be avoided.

6.2.16 Air and vapour control layer (AVCL)

AVCL's shall be specified and installed to restrict the passage of air and water vapour from within the home into the timber frame system.

An AVCL is a moisture vapour-resistant material located on, or near, the warm side of the thermal insulation. Its purpose is to restrict the passage of moisture vapour through the structure of the wall and mitigate the risk of interstitial condensation.

The designer should take account of how the AVCL should be installed on site to ensure adequate air tightness is achieved. This will include provision of laps at junctions e.g. immediate floors.

Specification

The AVCL may take the form of:

- A vapour control plasterboard.
- A minimum 125 micron thick (500 gauge) polythene sheet.
- A proprietary vapour control membrane product which has an appropriate third party product conformity certificate.

Criteria for a condensation risk analysis

For Warranty purposes, the boundary conditions for a condensation risk analysis should be as follows:

- 60% relative humidity.
- External temperature -2°C.
- Internal temperature 21°C.

Where external temperatures are considered to fall below -2°C due to exposure or geographical locations, lower temperatures should be used based upon climatic data within relevant standards.

Installation

A sheet membrane (polythene or proprietary) VCL should be:

- Securely fixed to and cover all areas of the timber frame external walls, including all sole plates, head binders, and lapped/sealed fully into window/door reveals. The VCL should be Fixed at 250mm centres to the top and bottom of the frame.
- Lapped and sealed by at least 100mm at joints. Joints in the VCL should occur over studs, rails or noggins and be mechanically fixed.
- Lapped and sealed over studs, rails or noggins.
- Sealed around service penetrations.
- Lapped and sealed with DPM/DPC at the junction with the ground floor/foundation by a minimum of 100mm.
- Made good where damage as occurred to the VCL.

Vapour control plasterboard should be:

- Fixed in accordance with the plasterboard manufacturer's installation guidance.
- Tightly cut and fitted around service penetrations.
- Discarded if the vapour control backing is damaged.
- Junctions, joints and penetrations (switches and sockets for example) should be appropriately detailed to ensure the vapour resistivity is not adversely comprised.

Notes:
- The AVCL should not be installed until the structural timber frame is below 20% moisture content and the building is weather tight.
- Small holes in the AVCL should be sealed with a suitable self-adhesive tape. If a proprietary membrane is being used, the manufacturer's proprietary sealing tape should be used. Larger holes should be re-covered to lap over adjacent studs and rails.

6.2.17 Internal wall linings

The internal wall lining shall provide an adequate surface to receive the intended finish required by the design. Supporting evidence will be required, where the wall lining is intended to perform additional functions (e.g. racking resistance, fire resistance or acoustic performance).

Wall linings are typically:

- Gypsum plasterboard.
- Fibre reinforced gypsum board.
- Cement bonded particle board.

Lining materials should satisfy all relevant performance criteria, e.g. fire resistance, acoustic performance and have a relevant third party product conformity certificate.

- Moisture resistance linings should be specified in high moisture environments (e.g. bathrooms).
- Internal linings should only be installed where the moisture content of the timber frame is less than 20%.
- We do not accept the use of MgO boards.

Plasterboard

Installation

Plasterboard must:

- Protect all areas of the timber frame structure.
- Have all edges supported by timber studs or rails.
- Be fixed in accordance with the plasterboard manufacturer's guidance.
- Be cut and tightly fit around service penetrations.
- Have junctions of wall and ceiling linings detailed to maintain continuity.
- Be installed using the specified number of layers to achieve the required fire resistance.
- Have all joints staggered when installing multiple layers.

Fixings

When fixing plasterboard linings:

- Each layer must be fully and independently fixed.
- Fixings of the correct length and centres should be installed in accordance with the plasterboard manufacturer's installation instructions.
- Walls requiring plasterboard to provide racking resistance should be clearly identified with plasterboard installed to the Engineer's specification or the plasterboard manufacturer's specification, whichever is more onerous.

6.2.18 Fire resistance

Timber frame walls shall have adequate fire resistance in accordance with the relevant Building Regulations. Supporting test evidence to an appropriate standard shall be made available upon request.

The designer should ensure timber framed walls and all associated components are fire resistance in accordance with the relevant Building Regulations.

Fire performance for openings

All openings including doors, windows, flues and ventilation ducts, should also be designed and constructed to maintain fire performance. The following should be taken into account:

- Internal reveals require equal fire resistance to the rest of the structure.
- Window fixing straps should not compromise the integrity of any fire-resistant reveal linings.
- Cavity barriers should be installed in the external wall cavity around the perimeter of openings. They must be mechanically fixed to rigid construction (for both vertical and horizontal positions).
- If profiled steel lintels are used as cavity barriers, triangular gaps behind lintels, which occur at each end, should be closed with careful positioning of adjacent cavity barriers.

6.2.19 Provision of cavities

Timber frame external walls shall be provided with a drained and vented cavity which resists the passage of moisture to the inside of the home and prevents interstitial condensation.

Minimum cavity width for different cladding types

External leaf	Minimum cavity width
Masonry	50mm
Render on un-backed lath	50mm
Render on backed lath or board	25mm
Timber	19mm
Tile hanging	25mm

Drained and vented cavity

Cavities should have openings to the outside air of not less than 500mm^2/m length of wall. Where cavities are not continuous (e.g. due to obstructions such as cavity barriers) each individual cavity should be vented. Drained and vented cavities should be provided in the following locations:

- At the base of the external wall concealed space.
- Above horizontal cavity barriers/trays.
- Over openings in the external wall cavity, e.g. windows and doors.

Measure should be taken to prevent the ingress of large insects, small mammals or birds and to avoid rainwater penetration. A nominal mesh/grill size of 4 mm should be used to avoid excessive resistance to airflow.

6.2.20 Cavity barriers

Cavity barriers shall be durable and must not adversely affect the structure of the external wall or the performance of the weatherproof envelope.

Where required by statutory regulations, cavity barriers shall:

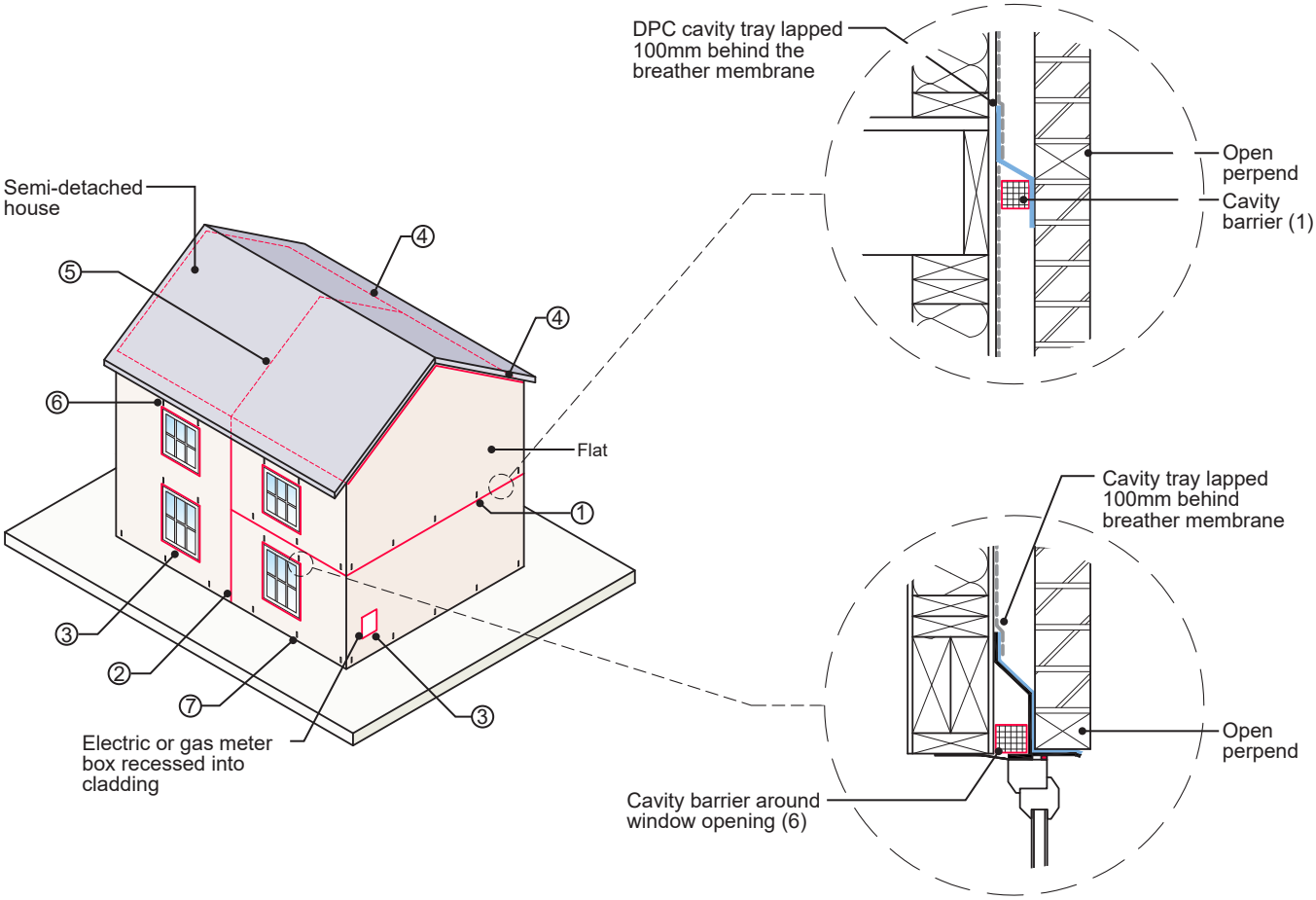
- Be of a suitable material.
- Specified and installed within the scope of the test certification and/or the third party product conformity certificate.
- Be installed in accordance with the manufacturer's recommendations.
- Be suitable for the location they are installed.

Where cavity barriers are required by statutory regulations, their specification, positioning and installation should satisfy the requirements of the Building Regulations.

Locations of cavity barriers and open perpends within the external wall

Notes

- Lightweight cladding systems will require a cavity barrier along the bottom of the cavity.
- Cavity barriers may also be required between walls and floors within the building, consult National Regulations for further guidance.



1. Cavity barriers are required at the junction of party floors and external walls (flats).
2. Cavity barriers are required at the junction of the external wall and the party wall.
3. Cavity barriers are required around the edges of all openings.
4. Cavity barriers are required at eaves and verge.
5. Cavity barriers/firestopping at the head of the party wall.
6. Open perpends over openings installed at maximum 900mm centres, with at least two over each opening.
7. Open perpends installed at maximum 1350mm centres to drain and ventilated external wall cavity.

Cavity barrier installation

Cavity barriers should be installed:

- So they fully close the cavity by friction fitting for the designed cavity width.
- Backed by solid timber studs, rails or floor joist at least 38mm wide.
- In accordance with manufacturer or independent certifier's guidance.
- So they are mechanically fixed to rigid construction (for both vertical and horizontal positions).

Where insulation is placed outside of the timber frame and where a cavity barrier is required, it must be fixed back to the timber frame structure.

Specification

Where vertical cavity barriers are required, they should be continuous for the full height of the wall and extend below DPC level.

Where horizontal cavity barriers are provided they must be tested for the scenario and have an third party product conformity certificate. A cavity tray should be installed directly above a horizontal cavity barrier and lapped up at least 100mm behind the breather membrane (except at eaves and verges).

Note: Lightweight cladding systems may require a cavity barrier along the bottom of the cavity. This may not be necessary however where a horizontal batten is present at the bottom of lightweight cladding systems.

Materials

Cavity barriers may be constructed from:

- Steel at least 0.5mm thick.
- Timber at least 38mm thick.
- A proprietary mineral wool product which has an appropriate third party product conformity certificate.
- Calcium silicate, cement-based or gypsum-based board at least 12mm thick.
- An independently assessed and certified proprietary product.

Timber cavity barriers should be protected from cladding by the use of a DPC. The cavity face of the barrier should be left uncovered to allow drainage and ventilation of the timber frame system. The use of timber cavity barriers around openings allows for effective sealing to be installed between them and the opening frame.

6.2.21 Forming weather resistant openings

Openings within the timber framed wall shall be designed and constructed to prevent the passage of moisture to the inside of the building. Particular attention shall be paid to:

- Detailing around reveals.
- Window sill detailing.
- Thermal performance and thermal bridging.
- Differential movement.

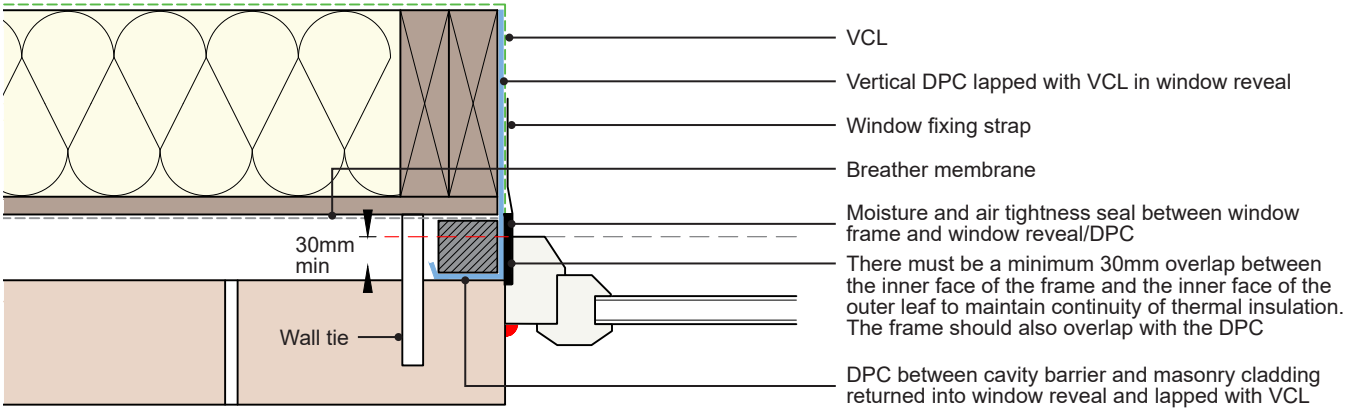
Openings shall also be designed and constructed to maintain fire and acoustic performance.

Detailing around reveals

A DPC should be provided between the cavity barrier and external cladding which is returned into window reveal and lapped with VCL. Where no DPC is used, breather membrane should be lapped with internal VCL.

There must be a minimum 30mm overlap between the inner face of the window/door frame and the inner face of the outer leaf to maintain continuity of thermal insulation. The frame should also overlap with the DPC.

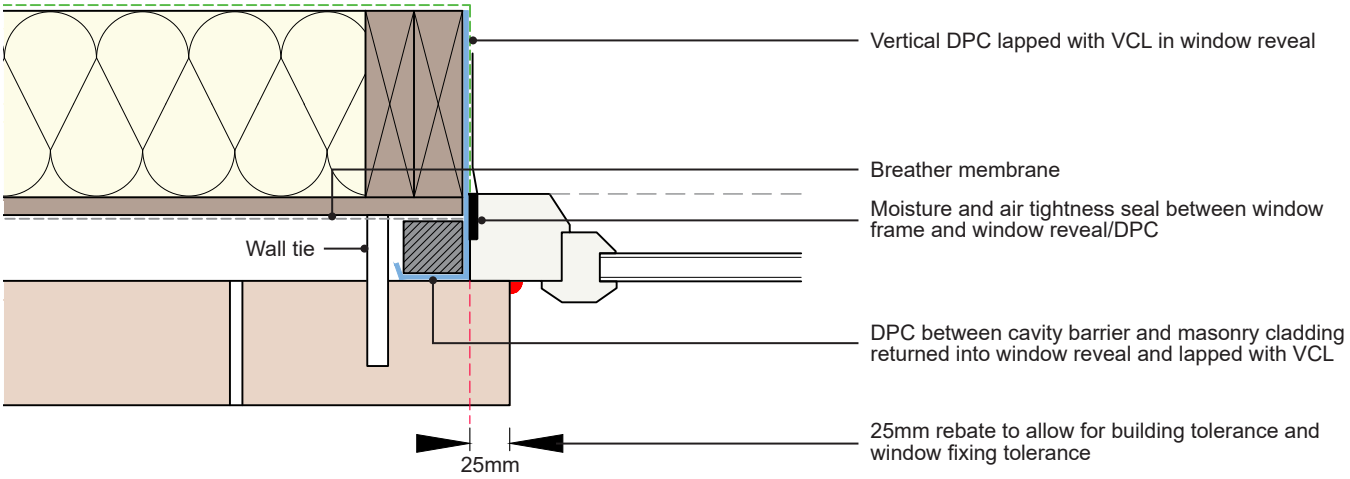
Typical window reveal detail (normal exposure)



Checked rebates

Checked (rebated) reveals are required in Scotland and in any areas of very severe exposure in England and Wales. The frame should be set back behind the outer leaf and should overlap.

For further information on external windows and doors please refer to the ‘External Windows and Doors’ section.

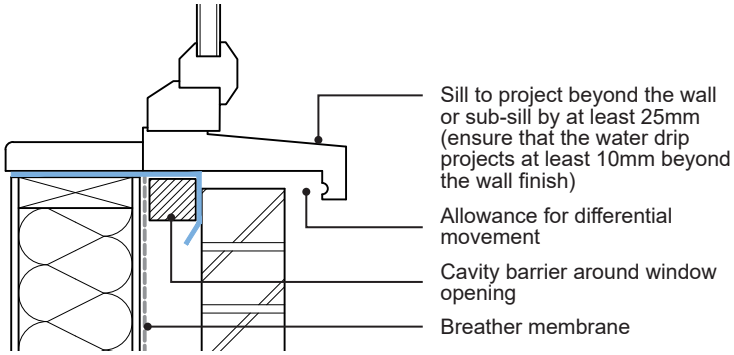


Thermal performance and thermal bridging

Detailing around openings should avoid thermal bridging and interstitial condensation. To avoid these issues, detailing should consider the following:

- The element being installed into the opening will have a minimum thermal performance.
- Junction between the window/door frame and the opening also has a thermal performance value assigned to it (psi value) designs may incorporate insulated reveals.
- The gaps between the timber frame wall and the element being installed into the opening may include the use of air sealing tapes, compressible seals or EPDM to promote thermal performance and continuity, weather tightness and air tightness.

Window sill detailing



Note: Internal linings have not been shown for clarity. A service void with additional insulation may be specified.

Differential movement

Materials should be chosen to provide an effective weather tight seal dependent on whether they are to be subjected to compression, expansion, or shear forces around openings. The weathertight seals around the openings should be checked once the maximum design differential settlement has occurred to ensure a weathertight seal is maintained.

Application of sealants

The use sealants around openings may not be provide the required performance in areas of high movement. Specifiers should consult with manufacturer’s for further guidance on performance in areas of compression, shear and expansion.

6.2.22 Cavity trays and their ancillary components

Cavity trays and their ancillary components shall be suitable and durable for their intended purpose and be provided to prevent moisture entering the home. The following should be taken into account:

- Specification
- Locations
- Drainage and ventilation
- Stop ends
- Installation of stepped cavity trays

Specification

Cavity trays should:

- Meet the requirements of BS EN 14909.
- Comply with the relevant Building Regulations.
- Have an appropriate third party product conformity certificate confirming suitability for use as a cavity tray.
- Rise at least 150mm from the outer to the inner leaf, be self-supporting or fully supported and have joints lapped and sealed.

Cavity trays should be proprietary preformed cavity tray systems at stepped and lower storey abutments, complicated junctions and around corners in low rise masonry walls.

Cavity trays should lap behind the breather membrane by at least 100mm to deflect moisture away from the sheathing. Cavity trays should be robustly fixed to the to a suitable substrate as detailed in the third party product conformity certificate.

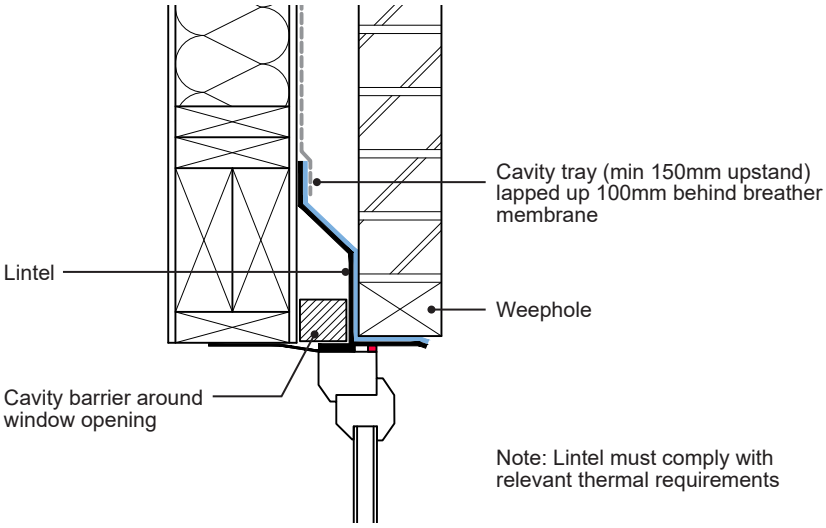
Please note: Polyethylene DPCs should not be used as a cavity tray. Please refer to ‘Appendix C’ for further guidance.

Locations

Cavity trays should be provided in the following locations:

- Above all openings and interruptions likely to direct rain water across the cavity such as window and door openings, rectangular ducts, lintels and recessed meter boxes.
- Above horizontal cavity barriers.
- Above cavity insulation that is not taken to the top of the wall, unless that area of wall is protected by impervious cladding e.g. where a spandrel is provided cold pitched roof.
- Continuously above lintels where openings are separated by short piers.
- Directly above openings that are under a compartment floor with a cavity barrier and cavity tray already present.

Cavity tray and lintel

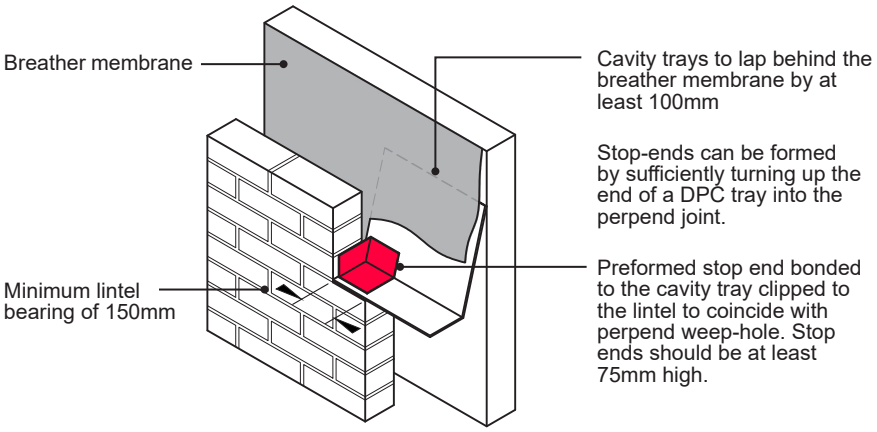


The detailing of the cavity tray will depend on the cladding type. For further information on masonry cladding, please refer to ‘External Walls – External Masonry Walls’ section.

Drainage and ventilation

Where cavity trays are provided there should be provision to drain moisture from the cavity with the use of cavity vents. Cavity vents should also be provided to promote ventilation of the timber frame (minimum 500mm^2/m run of wall). Cavity vents should prevent the ingress of moisture, insects or vermin.

Stop end to cavity tray



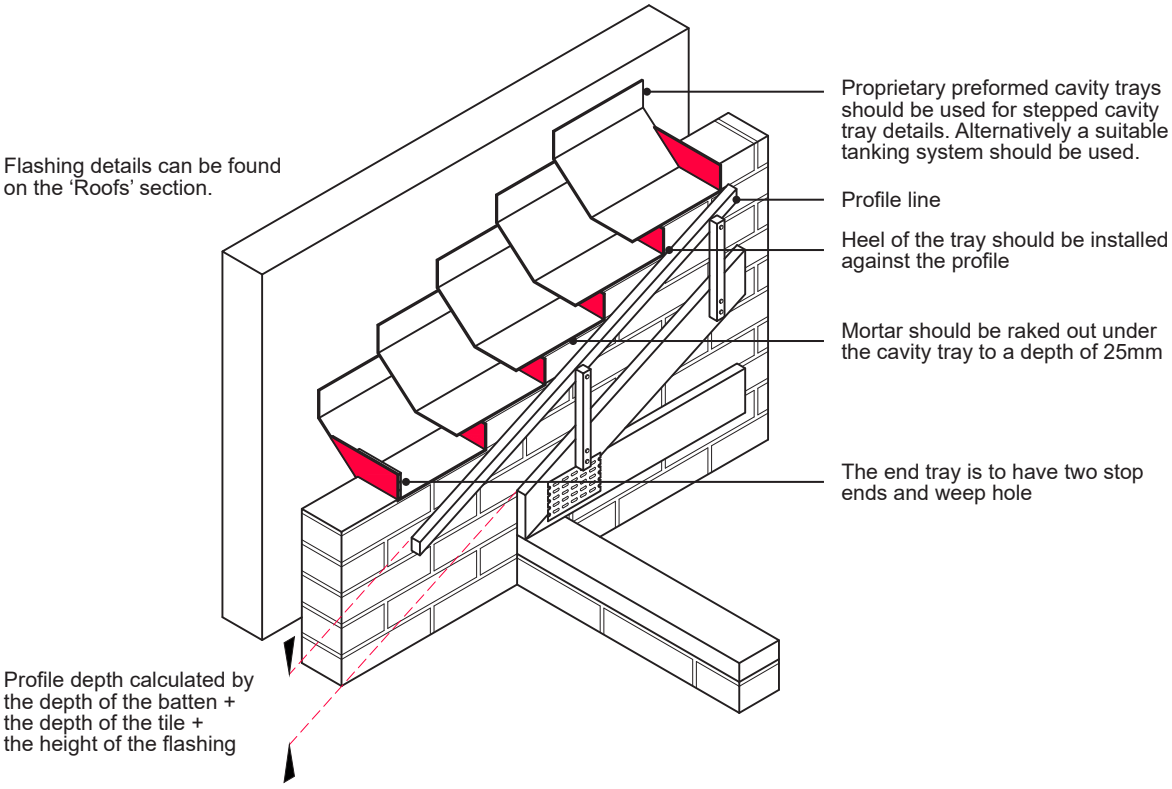
Installation of stepped cavity tray

Stepped cavity trays are required at all pitched (stepped) roof abutments with external walls, e.g. attached garages or staggered terraces.

Preformed rigid cavity trays should be used for stepped cavity tray details. Stepped cavity trays to lap behind breather membrane by at least 100mm. Additional measures may be needed to ensure the breather membrane adequately laps the tray to prevent moisture ingress behind the stepped cavity tray.

Where preformed rigid cavity trays are specified, they should be specified and installed to take account of differential movement between the timber frame and external cladding.

A lead cover flashing should be linked into the cavity tray (lapped in below). Flashing details can be found in the 'Roofs' section.



6.2.23 Claddings

External claddings for the timber frame building shall be durable and fixed back to structural timber as per the Engineers specification whilst maintaining a drained and vented cavity.

Claddings supported on the timber frame should be connected to it on vertical treated timber battens, or a carrier system, to form a drained and ventilated cavity to all areas of the external timber frame wall. These should be fixed into structural timber not just through the sheathing and to the Engineer's specification.

Please refer to the 'External Walls – External Masonry Walls' section where masonry cladding is specified.

For additional guidance on claddings supported on timber frame please see the 'External Walls - Render' and 'External Walls - Claddings' section.

For guidance on cavity barriers, please refer to the requirements within this section.

6.2.24 Calculating differential movement

The designer shall calculate the anticipated differential movement between the timber frame and other elements of construction to ensure the structural and weatherproof performance of the building is maintained.

Differential movement should account for shrinkage of the timber frame and any thermal expansion and moisture relation movement of the external cladding material.

Differential movement will therefore effect detailing such as:

- Windows and doors.
- Balconies and Juliet balconies.
- Rigid services e.g. copper gas and water pipes, dry risers, internal downpipes, SVP's and cable trays.
- Openings for services.
- Eaves and verges.
- Parapets.
- Cavity wall ties.
- Battens across floor zones.
- Junctions for mixed cladding designs.
- Lift shafts and stair wells of mixed construction.

The rates applied to shrinkage of the timber frame and thermal expansion/moisture related movement must be clearly stated in the design and specifications provided. For further details on applicable rates the relevant manufacturer's should be contacted.

Construction joints designed for differential movement should:

- Accommodate the expected amount of shrinkage or expansion safely.
- Provide a weather resistant and durable joint.
- Be protected with a cover strip where the movement joint is in excess of 35mm.

If fillers or seals are to be installed into differential movement gaps their fully compressed dimension, considering the area of the seal and force required to compress it, must be added to calculated gap size.

Materials should be chosen to provide an effective weather tight seal dependent on whether they are to be subjected to compression, expansion, or shear forces.

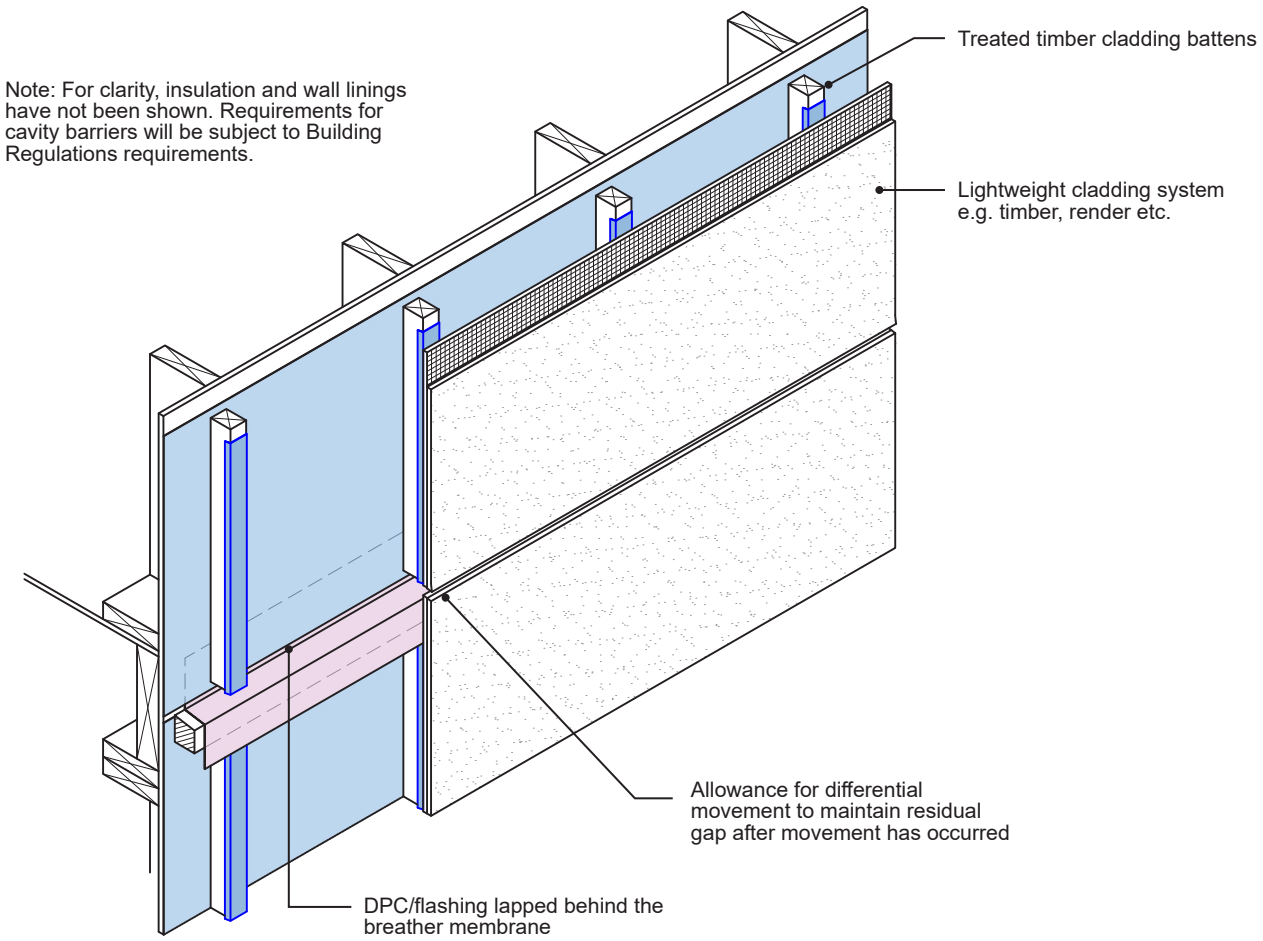
Gap sizes should allow for anticipated differential movement while allowing for drainage and ventilation requirements. Insect infestation should be avoided by using screens to cover gaps exceeding 4mm.

Lift shafts, stairwells and steel posts

Lift shafts and stairwells of mixed construction, and steel posts will require site specific calculations to work out the anticipated differential movement with the timber frame.

Differential movement at floor zone with cladding supported on timber frame

Vertical timber battens or other rigid cladding support systems should not span over the floor zones of timber frame buildings. Gaps should be provided to accommodate anticipated differential movement and the compressed size of any filler. Movement should be calculated individually for each floor zone using the formula of 1mm for every 38mm of horizontal cross grain timber.



For additional guidance on claddings supported on timber frame please see the 'External Walls - Claddings' section 'of the Technical Manual.

6.2.25 Services

Where services pass through the timber frame panel they shall be specified and installed to:

- Ensure the structural integrity of the timber frame panel is unaffected.
- Prevent moisture ingress.
- Allow for differential movement where applicable.

Any penetrations to the timber frame panel be fully considered in the design in order to avoid unintended removal or alteration of structural timbers.

Where services pass through the timber frame panel they should be designed to prevent moisture transfer to the timber frame. Penetrations services such as flues and vents should include noggings to facilitate any enclosing cavity barriers and protected with a cavity tray.

Rigid services require specific detailing when passing horizontally or vertically through the timber frame panel to allow for differential movement, this should be calculated by the timber frame designer in line with the guidance in this section and provided to the relevant service installer to allow for appropriate installation details.

All service penetration should be carried out to maintain acoustic performance. The following should be taken into account:

- Seal gaps between timber frame wall and the element being installed into the opening.
- The element being installed into the opening may have a minimum acoustic requirement.