

# FUNCTIONAL REQUIREMENTS

## 7.3 TIMBER FRAME

### Workmanship

- i. All workmanship must be within the tolerances defined in Chapter 1 of this Manual.
- ii. All work is to be carried out by a technically competent person in a workmanlike manner.
- iii. Certification is required for any work completed by an approved installer.

### Materials

- i. All materials should be stored correctly in a manner that will not cause damage or deterioration of the product. Timber frame elements should be appropriately protected to keep components dry.
- ii. All materials, products and building systems shall be appropriate and suitable for their intended purpose.
- iii. The structure shall, unless specifically agreed otherwise with the Warranty provider, have a life of not less than 60 years. Individual components and assemblies, not integral to the structure, may have a lesser durability, but not in any circumstances less than 15 years.

### Design

- i. The design and specifications shall provide a clear indication of the design intent and demonstrate a satisfactory level of performance, supported by structural calculations provided by a suitably qualified expert.
- ii. The materials, design and construction must meet the relevant regional building regulations.
- iii. Any off-site manufactured engineered beams/posts must have structural calculations endorsed by the manufacturer.

### Limitations of Functional Requirements

- i. The Functional Requirements are limited by the recommendations applied to the specific areas covered in this chapter.
- ii. These Functional Requirements do not and will not apply to create any policy liability for any remedial works carried out by the contractor or otherwise, nor to any materials used in those remedial works.

## CHAPTER 7: Superstructure

## 7.3.1 Specifications

## 7.3.1.1 Introduction

This chapter refers to 'conventional' timber frame open panel systems made off-site under factory conditions. Such panel systems are required to be manufactured and erected on-site under quality assured systems and be either Structural Timber Association or BM TRADA registered.

Alternatively, any timber frame kit, system or wall panel that has been approved via the Warranty product approval process will be acceptable.

Timber frame external walls are generally considered to consist of load-bearing solid timber studs at regular centres with insulation between them, lined with a structural sheathing board, breather membrane, drained cavity and cladding. A Vapour control layer (VCL) and fire-resistant linings are provided to the internal finishes.

For guidance on other forms of timber construction, e.g. SIPs, I section studs, glulam, cross laminated timber (CLT) etc., please refer to Chapter 3 – Modern Methods of Construction, in this Manual.

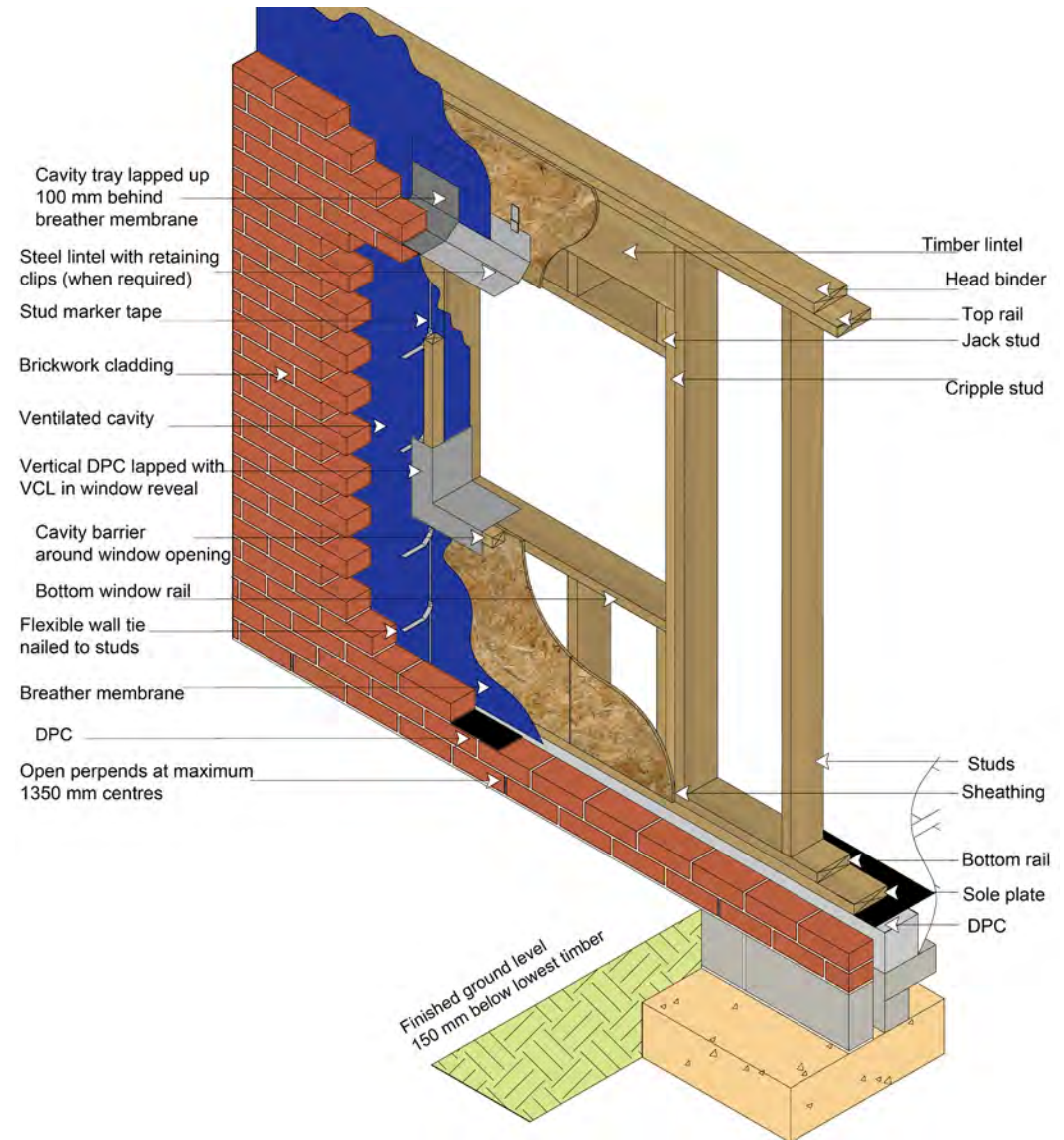


Figure 1: Typical timber frame external wall

## CHAPTER 7: Superstructure

**7.3.1.2 General specifications**

Note: Bespoke timber frame open panel systems that do not have such QA procedures as the 'conventional' timber frame open panel systems described in Chapter 7.3.1.1 will need either third-party accreditation or independent Structural Engineer supervision and monitoring of the installation, erection and completion (sign off) of the system. All load-bearing timbers will have to be preservative treated in accordance with BS 8417 according to their position within the frame, and evidence of treatment must be provided.

Green oak is not acceptable for use in external wall, frame or internal wall or roof constructions, regardless of whether it forms part of the waterproof envelope or not. Projects incorporating 'green Oak' will not be acceptable for Warranty cover. Green Oak is defined for Warranty purposes as 'Oak that has been freshly cut or air dried'.

Certified Kiln dried oak with a certified moisture content of 12% may be acceptable for parts of the structure where the oak does not form part of the waterproof envelope, or movement in the oak frame will not affect the waterproof envelope.

Structurally Insulated Panels (SIPs) are a form of stressed skin composite panel. Only systems with independent third-party certification will meet the requirements of the Technical Manual, please refer to chapter 3. All detailing requirements for timber frame contained within this chapter will also be applicable to SIPs.

**7.3.1.3 Structural design**

Wind, roof and floor loads should be considered in the design and all timber frame structures shall be designed in accordance with Eurocode 5. Structures designed in accordance with BS 5268 may still be acceptable, although these standards have now been superseded by Eurocode 5.

**Quality assurance**

All timber Frame Designers, Manufacturers and Erectors should possess current certification from at least one of the following quality assurance schemes:

- BM TRADA QMark for timber frame
- ISO 9001
- CE Marking when EN 14732 is published
- Other relevant third party quality assurance scheme

**7.3.1.4 Timber specifications****Grading of structural timber**

All structural timber whether machine or visually graded shall be graded in accordance with BS EN 14081: Timber structures – Strength graded structural timber with rectangular cross section. All load-bearing solid timber studs, rails, binders and sole plates should be of a minimum dry graded C16.



Figure 2: Typical grading stamp

**Sizing of structural timber**

Timber studs and rails shall be a minimum of 37mm in width.

**Treatment of structural timber**

All load-bearing timber components shall be either naturally durable or 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'.

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.

## CHAPTER 7: Superstructure

**Sole plates**

The Sole plate is the first structural timber component installed on-site. Its purpose is to set out the building, transfer loads to the foundations and provide a level base for erecting the wall panels. All structural timber should be located at least 150mm above finished external ground level, except for localised ramping (incorporating satisfactory drainage and ventilation detailing) around door openings.

Sole plates should be fixed to the foundations with shot fired nails, proprietary sole plate fixings, anchors, brackets or straps as specified by a Structural Engineer.

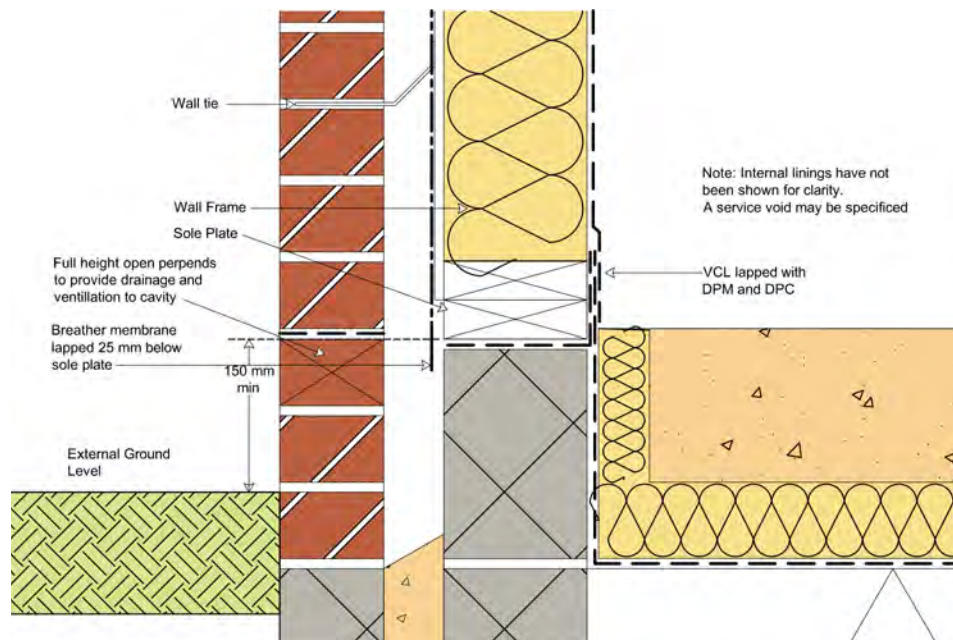


Figure 3: Sole plate/foundation junctions

**Sheathing boards**

Sheathing boards are fixed to the timber frame in order to provide racking resistance to the structure.

Structural sheathing board materials may be any of the following:

- Orientated Strand Board (OSB)
- Plywood
- Impregnated soft board
- Other board material with suitable third-party certification

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

OSB should be grade 3 or 4 in accordance with BS EN 300: Oriented Strand Boards (OSB) – Definitions, classification and specifications.

Plywood should be Class 3 Structural in accordance with BS EN 636: Plywood Specifications.

Impregnated soft boards should be Type SB.HLS in accordance with BS EN 622-4: Fibreboards. Specifications. Requirements for soft boards.

## CHAPTER 7: Superstructure

**7.3.1.5 Other material specifications****Fixings**

All sole plate fixings and holding down products should be austenitic stainless steel.

Timber framing components and structural sheathing boards may be fixed with:

- Nails
- Staples

Nail fixings should be:

- Austenitic stainless steel
- Galvanised
- Sheradised

Staple fixings should be austenitic stainless steel or similar.

**Breather membrane**

A breather membrane is a water-resistant, moisture vapour permeable membrane used to provide temporary weather protection during construction, and secondary protection from moisture once the building is complete.

The timber frame structure should always be protected by a breather membrane facing the external wall cavity.

Breather membranes should be:

- Minimum Class W2 or better in accordance with BS EN 13859: Flexible sheets for waterproofing – Definitions and characteristics of underlays.
- Securely fixed to protect the outside face of the timber frame structure with austenitic stainless steel staples.

**Cavity barriers**

Cavity barriers are required to prevent the spread of smoke and flame within concealed spaces.

Cavity barriers may be constructed from:

- Steel at least 0.5mm thick
- Timber at least 38mm thick
- Polythene sleeved mineral wool
- Mineral wool slab
- Calcium silicate, cement-based or gypsum-based board at least 12mm thick
- An independently assessed and certified proprietary product

**Insulation materials**

Insulation materials should be chosen with consideration for their breathability and interaction with the timber frame.

Thermal insulation products typically used are:

- Mineral fibre (glass or rock)
- Wood fibre/wool
- Blown cellulose

Other insulation materials may be used, subject to relevant third-party certification.

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

- Between the load-bearing studs
- On the outside of the timber frame
- On the inside of the timber frame

Insulation installed to the outside of the timber frame structure should have third-party certification for this application and retain a clear cavity dimension, as detailed in Table 1 in Chapter 7.3.4. The outer layer of insulation should also be covered with a breather membrane adjacent to the cavity.

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.



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**Vapour control layer (VCL)**

A VCL 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.
- Mitigate the risk of interstitial condensation.

The VCL should have a minimum vapour resistance of 250 MN.s/g or 0.25 Pa/m<sup>2</sup>. It is also typically used as an air tightness layer.

The VCL may take the form of:

- A vapour control plasterboard comprising a metallised polyester film bonded to the back face of the plasterboard.
- A minimum 125 micron thick (500 gauge) polythene sheet.
- A third-party approved proprietary Vapour Control Membrane product.

Subject to a favourable condensation risk analysis, a novel or reverse wall construction may not require the use of a high moisture vapour-resistant Vapour Control Membrane.

**Wall linings**

The internal lining of the timber frame wall may be required to perform four functions:

- Provide the finish or a substrate to accept the finish on the inner face of the wall.
- Contribute to the racking resistance of the wall.
- Contribute to the fire resistance of the wall.
- Contribute to the acoustic performance of the wall.

Wall linings are typically:

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

Lining materials must satisfy all relevant performance criteria, e.g. fire resistance, acoustic performance and have relevant third-party certification.

**Masonry supporting timber frame, foundations, kerb upstands, etc.**

Foundations and masonry supporting timber frame structures should be in accordance with the relevant Technical Manual Chapter, as indicated below:

- Chapter 2 – Materials
- Chapter 4 – Site Investigation
- Chapter 5 – Foundations
- Chapter 6 – Substructure
- Chapter 7 – Superstructure

**Claddings**

Timber frame external walls should be finished externally with a cladding system, which may take the form of masonry or a lightweight rain screen system. Regardless of the cladding system used, a cavity with provision for drainage and ventilation should be provided between the cladding and the timber frame.

**Wall ties**

External wall ties and fixings between the timber frame and masonry cladding shall:

- Comply with BS EN 845: Specification for ancillary components for masonry, ties, tension straps, hangers and brackets.
- Be constructed from austenitic stainless steel.
- Accommodate all anticipated differential movement.
- Be of adequate length and masonry bond to provide a clear cavity of at least 50mm.
- Be installed into solid timber studs.

## CHAPTER 7: Superstructure

## 7.3.2 Manufacture

## 7.3.2.1 Timber

All structural timber components should be specified in accordance with the requirements of Chapter 7.3.1.

Timber frame external wall panels shall:

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

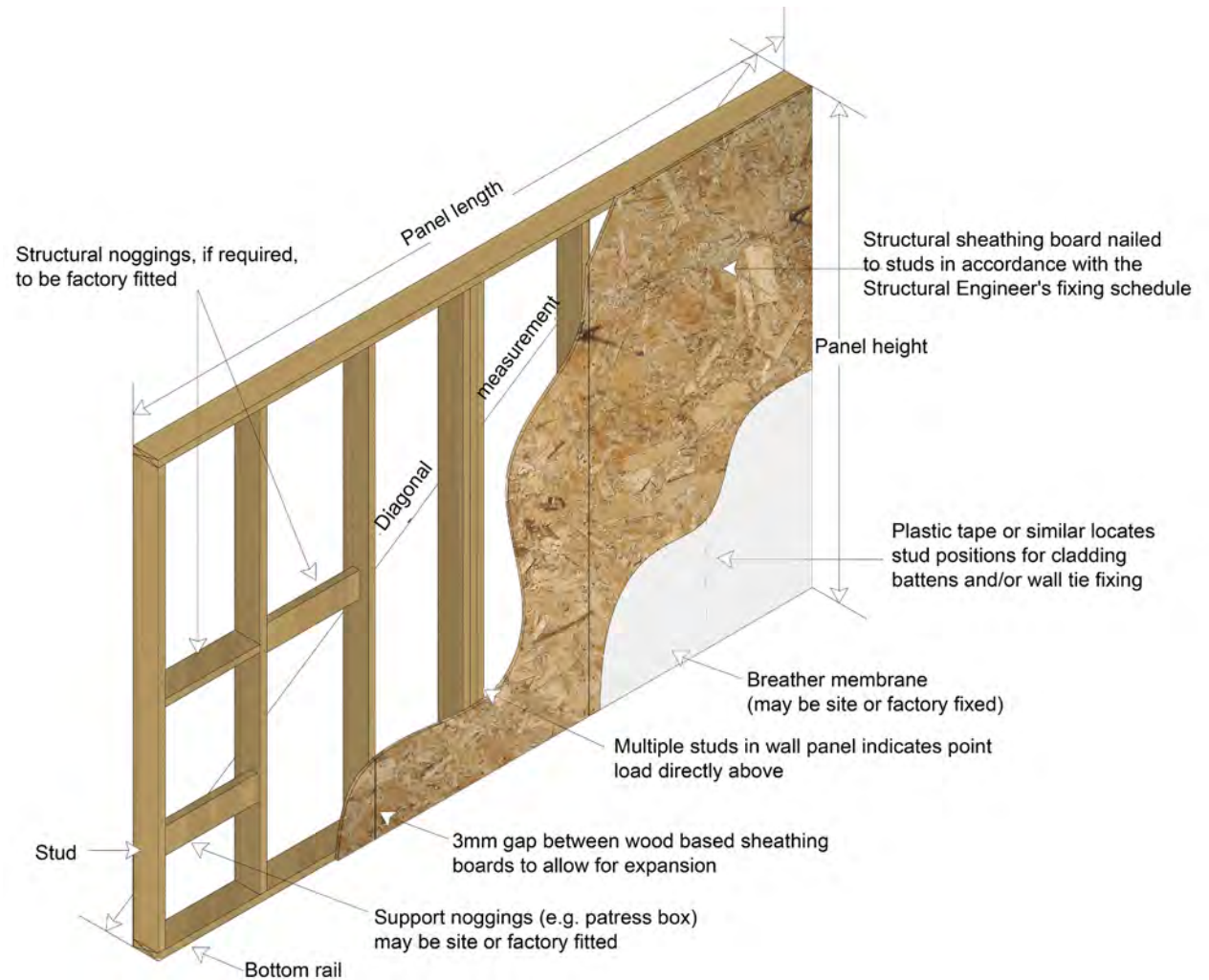


Figure 4: Typical wall panel

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**7.3.2.2 Panel 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 waterproof sheet material, as shown in Figure 6.

**7.3.2.3 Manufacturing tolerances**

Based on the tolerances given in prEN 14732 (dated 17/12/2013) wall panels shall be manufactured to the following tolerances;

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

**7.3.2.4 Sheathing**

The fixings securing the structural sheathing board to the timber studwork wall panels provide racking resistance as calculated by the Structural Engineer.

The sheathing board shall be fixed to the timber studwork in strict accordance with the Structural 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.

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.

**7.3.2.5 Studs**

Studs should be accurately cut to length and bear tightly against the wall panel top and bottom rails.

Any point load imparted onto the timber frame should be transferred down through the building to the foundations with the use of multiple studs. If these are not installed during the manufacture of the panels, the requirement for installation must be clearly conveyed to site.

Wall panels should be designed to minimise thermal bridging. Gaps between studs within the wall panel and at wall panel junctions should be large enough to allow the installation of insulation.

**7.3.2.6 Openings**

All openings, including doors, windows, flues and ventilation ducts, should be designed and constructed to maintain structural performance:

- A lintel may be required where openings do not fall between studs, unless vertical load is adequately transferred by other elements.
- Lintels will require support by cripple studs.
- 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.

**7.3.2.7 Breather membrane**

Breather membranes should be lapped by a minimum of 100mm at horizontal joints, and a minimum of 150mm at vertical joints. 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.

The location of solid timber studs should be clearly marked on the outer face of the breather membrane to ensure that cladding fixings are installed into solid timber.

**7.3.2.8 Closed panel construction**

If wall panels are to be of closed panel construction, the guidance in Chapter 7.3.4 applies equally to manufacture. For the purposes of this Manual, closed panels are classified as open panels with at least insulation installed in the factory.

Special precautions must be taken to protect closed panels from moisture during storage, transportation and erection on-site.

**7.3.3 Site preparation and erection****7.3.3.1 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.



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**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

If ground conditions require gas membranes, they should be located so as not to inhibit drainage and ventilation to all areas of the timber frame structure.

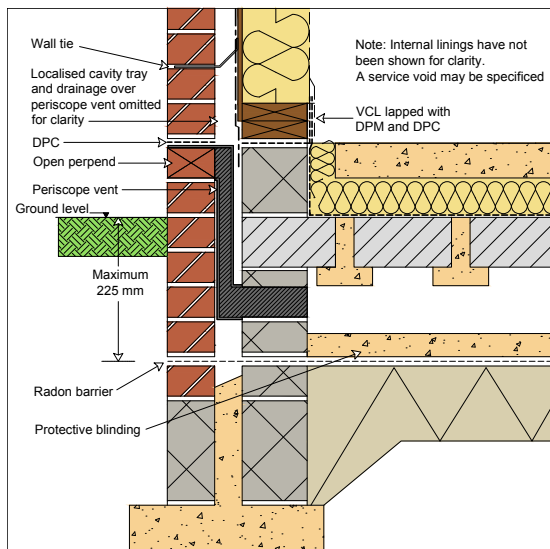


Figure 5: Possible gas membrane detail

**Timber frame delivery and storage**

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.
- Below 20% moisture content.
- Confirmed as square by sample checking for equal diagonal measurements, lengths and heights.

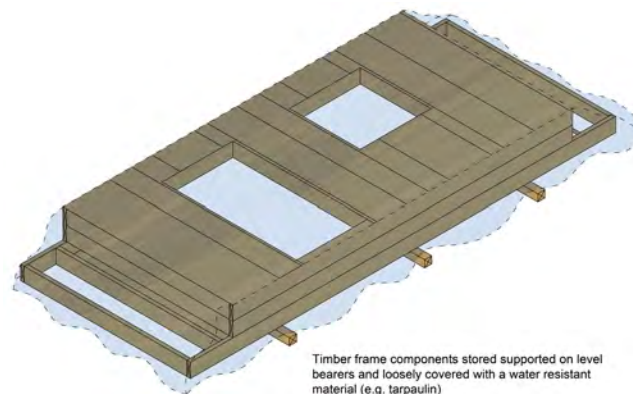


Figure 6: Storage of wall panels

**7.3.3.2 Timber frame erection****Sole plates**

The sole plate should be accurately levelled, located and securely fixed to the substructure as specified by the Structural Engineer. Where no sole plate is specified, the following guidance applies equally to wall panel bottom rails. Timber sole plates should be preservative treated in accordance with Chapter 7.3.1.3 – Timber Specifications, Treatment of Structural Timber.

**Location**

Sole plates should:

- Be located so that all structural timber is at least 150mm above external ground level (except for localised ramping at door openings). The use of a masonry foundation kerb upstand may be an appropriate method to achieve this as shown in Figure 8.
- Internal and party wall timber sole plates should not be installed below internal finished floor level. The use of a masonry foundation kerb upstand may be an appropriate method to achieve this.
- Be levelled to +/-5mm from datum.
- Not overhang or be set back from the foundation edge by more than 10mm.
- 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 +/-10mm for more than 10m.

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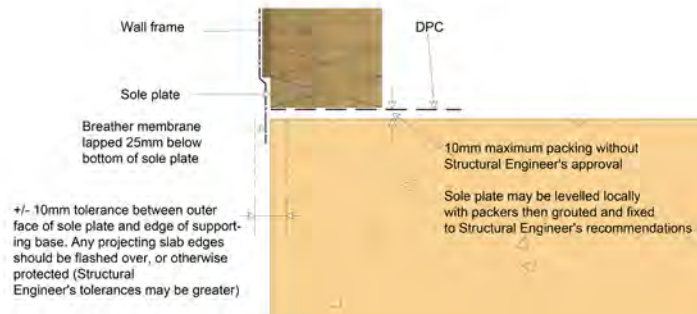


Figure 7: Locating sole plates

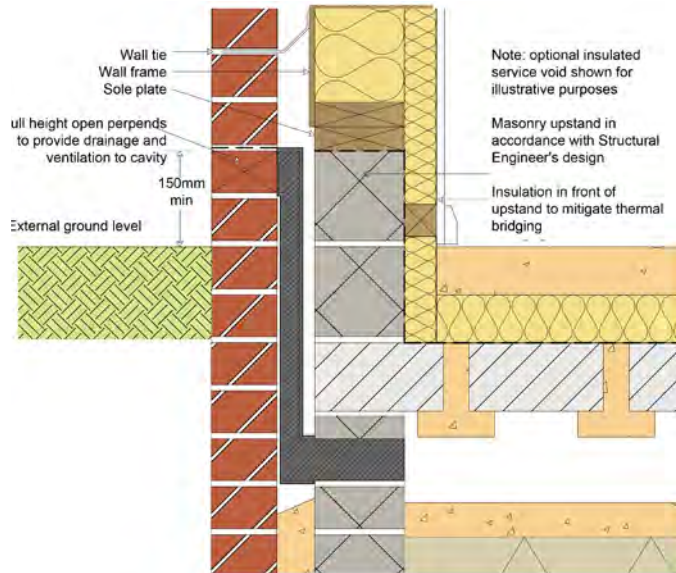


Figure 8: Kerb upstand detail to allow level threshold

**Damp Proof Course (DPC)**

A DPC should:

- Be located directly below all timber sole plates bearing on other materials that may transfer moisture.
- Overlap at DPC junctions by at least 100mm.
- Be located flush to the outside edge of the sole plate.

**Packing**

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

Structural shims should:

- Be non-compressible and inert.
- Be located under every stud.
- Provide an equal cross sectional area to the studs they support.
- Be located under sole plates to provide full width bearing to studs.
- Provide full bearing under point loads.
- Not exceed a total of 10mm in height without a Structural Engineer's approval.

Structural grout should be:

- Considered for use by a Structural Engineer for gaps exceeding 10mm.
- Non-shrinkable.
- Full bearing under sole plates.
- Packed under the DPC.

**Note:** The use of structural grout is not considered suitable for gaps less than 10mm due to installation difficulties.

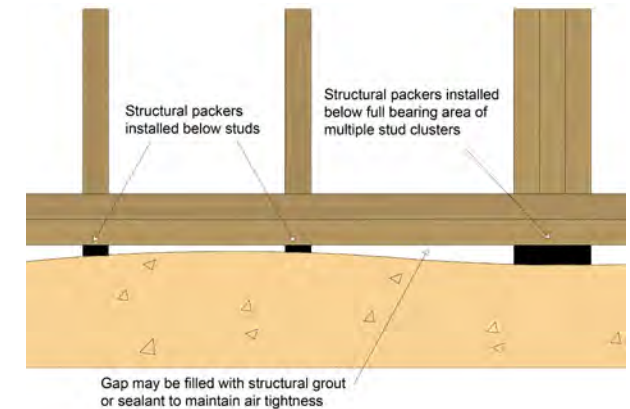


Figure 9: Packing of sole plates

**Fixings**

Fixings should:

- Be installed to the Structural Engineer's 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.

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**Wall panel erection tolerances**

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.

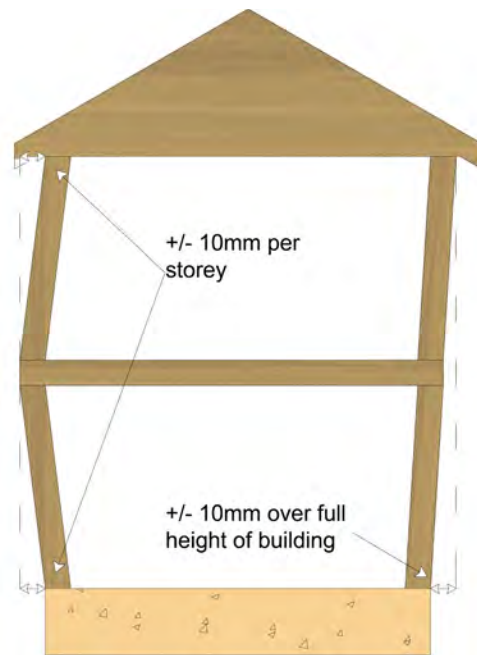


Figure 10: Wall panel erection tolerances

**Fixings and junctions**

All fixings are to be installed to the Structural 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 must be installed to the full width of point load-bearings.
- Point loads must be transferred down through wall panels and floor zones to foundations.
- Closed panel walls manufactured off-site must be fixed together as specified.
- Special considerations should be given to protecting closed panels from exposure to moisture during delivery, storage and erection. Closed panel walls should not be exposed for longer than necessary to avoid moisture ingress.
- 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.

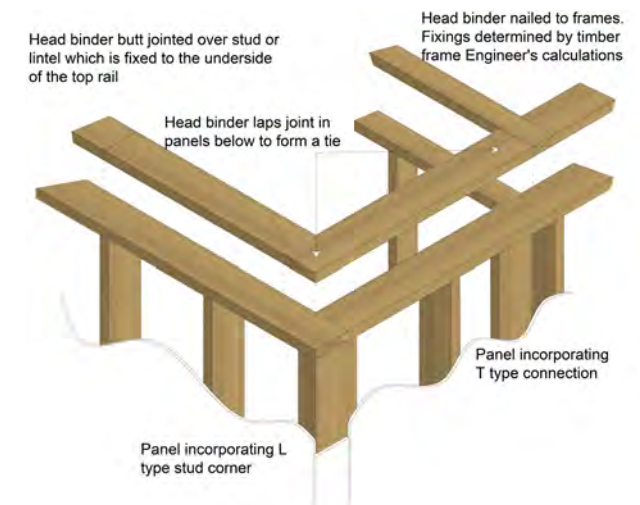


Figure 11: Head binder lapping

**Air leakage**

Detailing and installation instructions must be followed to achieve adequate air tightness.

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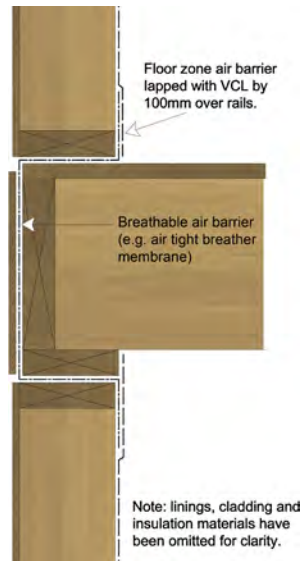


Figure 12: Typical floor zone air tightness detail

**Breather membrane**

Breather membrane should be:

- Placed on the outside of the timber structure and any external insulation adjacent to the external wall cavity.
- Lapped to deflect moisture away from the timber frame structure.
- Lapped by a minimum of 100mm at horizontal joints and a minimum of 150mm at vertical joints.
- Trimmed to leave a 25mm lap below the lowest timber sole plate.
- Repaired if damaged.

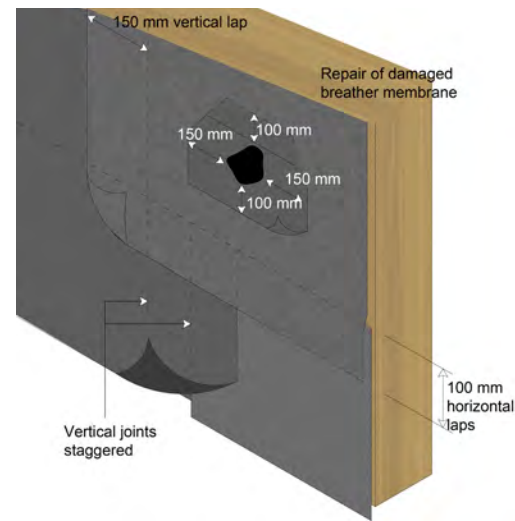


Figure 13: Lapping and repair of breather membrane

**7.3.3.3 Cavity barriers****Location**

In England and Wales, cavity barriers shall be installed:

- At the edges of all cavities, including around openings, e.g. windows and doors.
- Between an external cavity wall and a compartment wall or compartment floor.
- Around meter boxes in external walls.
- Around service penetrations in external walls, e.g. extract duct or boiler flue.
- To sub-divide extensive cavities; please refer to national regulations for specific requirements.

**Note:** Cavity barriers may also be required between walls and floors within the building, consult National Regulations for further guidance.

**Note:** Lightweight cladding systems will require a cavity barrier along the bottom edge of the cavity.

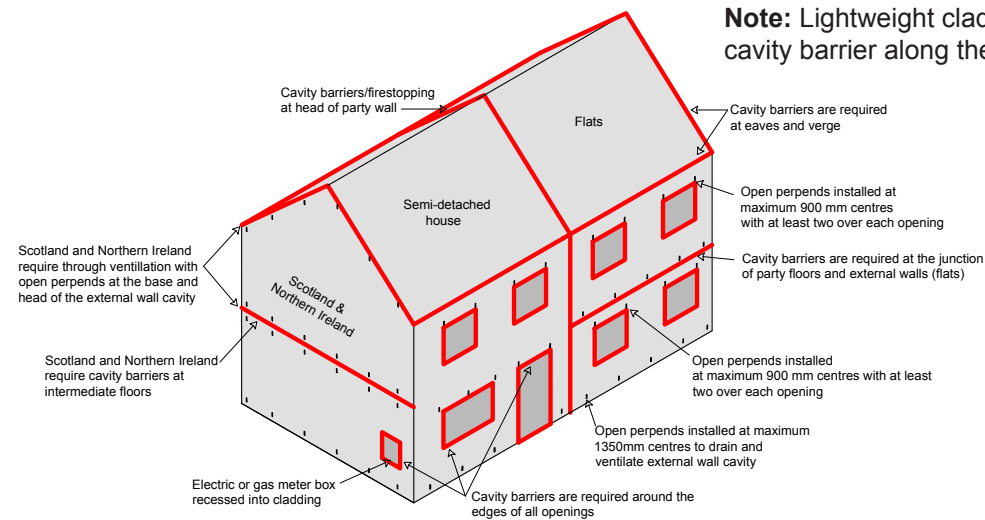


Figure 14: Locations of cavity barriers and open perpend



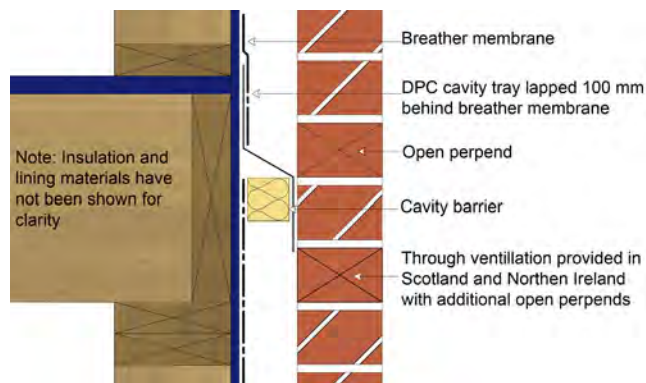
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**Installation**

Cavity barriers shall be installed:

- So they fully close the cavity.
- So the ends are tightly butted to form a continuous barrier.
- Backed by solid timber studs, rails or floor joist at least 38mm wide.
- In accordance with manufacturer or independent certifier's guidance.

A cavity tray should be provided directly above a horizontal cavity barrier and lapped at least 100mm behind the breather membrane (except at eaves and verges).



**Figure 15: Cavity tray above horizontal cavity barrier**

Timber cavity barriers should be protected from masonry and lightweight render 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. The use of timber cavity barriers around openings allows for effective sealing to be installed between them and the opening frame.

**7.3.4 Main contractor****7.3.4.1 Insulation**

If insulation is specified between external walls studs, all voids shall be filled with insulation to maintain the thermal envelope of the building. When noggings 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.

If external wall insulation is to be used:

- Insulation should be installed in a manner to maintain its stated performance by minimising gaps that lead to thermal bridging and air washing.
- Installation should be covered with a breather membrane to ensure that external wall cavity moisture does not become trapped in or between the insulation and the timber frame.
- Cavity trays should be fixed and lapped over the cavity facing breather membrane to deflect cavity moisture away from the timber frame.
- Allowance should be made for differential movement to occur at floor zones.

- Cavity barriers should be tightly fitting and remain effective in a fire. Depending in the type of insulation used, cavity barriers may need to pass through the insulation, back to solid timber within the timber frame structure behind.
- 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.
- Joints between foil faced insulation boards must not be taped.

**7.3.4.2 Services**

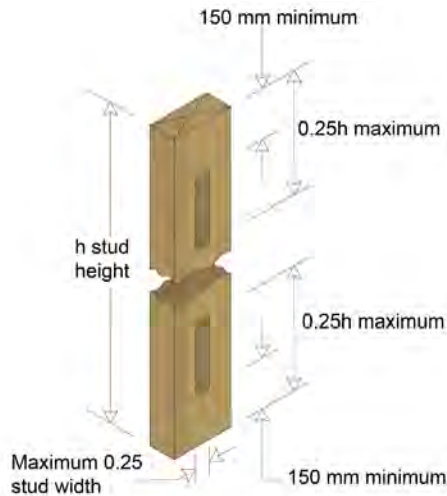
In addition to general provisions for the installation of services, the following are of particular note for timber frame construction external walls:

- The routing and termination of services should not affect the fire resistance of the structure.
- Electrical services are to be rated for their location with consideration for insulation.
- Wet services are not to be installed on the cold side of the insulation.
- Service penetrations through the VCL should be tight fitting to reduce air leakage and the passage of moisture vapour.
- Avoid running electrical services in the external wall cavity, except for meter tails.



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- Services should be protected with metal plates if they pass within 25mm from face of stud. Adequate allowance for differential movement to occur without causing damage should be provided for rigid services rising vertically through a building.
- Services that pass through the external wall cavity and provide an opening (such as flues/vents) should be enclosed with a cavity barrier and protected with a cavity tray.



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

Figure 16: Drilling of studs

### 7.3.4.3 Vapour control layer (VCL)

A VCL should not be installed until the structural timber frame is below 20% moisture content and the building is weather tight.

#### 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 window/door reveals.
- Lapped and sealed by at least 100mm at joints.
- Lapped and sealed over studs, rails or noggings.
- Sealed around service penetrations.
- Lapped and sealed fully into window and door reveals.
- Lapped and sealed with DPM/DPC at the junction with the ground floor/foundation by a minimum of 100mm.

**Note:** Small holes in the VCL 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.

Vapour control plasterboard should be:

- Fixed in accordance with the plasterboard manufacturer's installation guidance.
- Tightly cut and fitted around service penetration.
- Discarded if the vapour control backing is damaged.

### 7.3.4.4 Plasterboard Installation

In order to provide the specified period of fire resistance, the 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.

#### Fixing of plasterboard

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 Structural Engineer's specification or the plasterboard manufacturer's specification, whichever is more onerous.

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**7.3.4.5 Openings**

All openings, including doors, windows, flues and ventilation ducts, should be designed and constructed to maintain:

**Fire performance**

- 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.
- 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.

**Acoustic performance**

- 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.

Weather tightness and thermal performance, including thermal bridging and air tightness:

- The element being installed into the opening is likely to have a minimum thermal performance.
- Seal gaps between the timber frame wall and the element being installed into the opening to provide thermal performance, weather tightness and air tightness.
- Cavity trays should be installed over the heads of all openings, lapped behind the breather membrane by a minimum of 100mm. A flashing may be acceptable for some types of claddings.

- Lap cavity barrier DPC with internal VCL around openings. Where no DPC is used, breather membrane should be lapped with internal VCL.

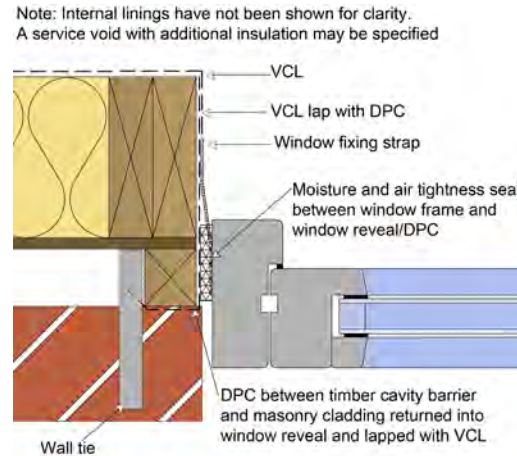


Figure 17: Window/wall junction (jamb)

**7.3.4.6 Claddings**

All external wall claddings should be separated from the timber frame structure by a drained and ventilated clear cavity. If partial fill cavity insulation is to be used, the same width of clear cavity is to be maintained in addition to the insulation depth. In some locations, for example close to boundaries, National Regulations require claddings to provide fire resistance to the structure from the outside in.

Cavity barriers must be provided to meet National Regulations.

**Self-supporting claddings (masonry)**

Self-supporting (masonry) claddings should be connected to the timber frame using wall ties:

- Installed into studs provided around openings and movement joints, not just through sheathing.
- Angled to drain moisture away from the timber frame, even after differential movement has occurred.
- Installed at a minimum density of 4.4/m<sup>2</sup> (a maximum of 375mm vertically with studs at 600mm centres and a maximum of 525mm vertically where studs are at 400mm centres). Closer centres may be required in exposed locations.
- Installed at a maximum of 300mm centres vertically and 225mm horizontally around openings and movement joints.
- Installed within 225mm of the head of a wall.
- Studs should be provided in the timber frame structure to provide support for wall ties at vertical movement joints in the masonry cladding.

Cavity drainage and ventilation in masonry cladding should:

- Be provided with the use of full height open perpend at a maximum of 1350mm centres or equivalent open area.
- Be fitted in the brick or block course below the lowest timber sole plate, above external finished ground level and below DPC.
- Be provided to ensure drainage and ventilation to each external wall concealed space, directly above horizontal cavity barriers/trays.

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- Be installed over openings in the external wall cavity, e.g. windows and doors, at a maximum of 900mm centres.
- Maintain a clear cavity, with care taken to reduce mortar droppings at the base of the wall.

Weep-holes alone are unsuitable for timber frame construction, and open perpend should be used. Proprietary open perpend inserts are available with insect screening incorporated. Their equivalent open area must be considered and installation centres reduced accordingly.

In areas of severe or very severe exposure, check reveals should be constructed to provide additional weather protection.

Vertical loadings from masonry claddings must not be supported by the timber frame structure.

#### Claddings supported on the timber frame

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, to the Structural Engineer's specification.

Cavity drainage and ventilation should provide an open area of not less than 500mm<sup>2</sup> per metre run:

- 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.
- Allowing differential movement to occur while retaining an adequate gap.
- With openings protected by a mesh to prevent the passage of insects.

Timber frame with external wall minimum cavity widths	
Masonry	50mm
Render on unbacked lath	50mm
Render on backed lath or board	25mm
Timber	19mm
Tile hanging	25mm

Table 1: Minimum cavity widths

#### 7.3.5 Differential movement

Appropriate allowances must be made for differential movement to occur without causing damage to the building.

Differential vertical movement occurs as a result of compression, closing of gaps and shrinkage of the timber frame structure, and occurs during the first 24 months following completion. Shrinkage occurs across the grain and is due to a reduction in the moisture content of timber elements. The shrinkage of plates, rails, binders, floor and roof joists should be considered. The building should be designed to ensure that differential movement occurs evenly to external elevations and the internal structure.

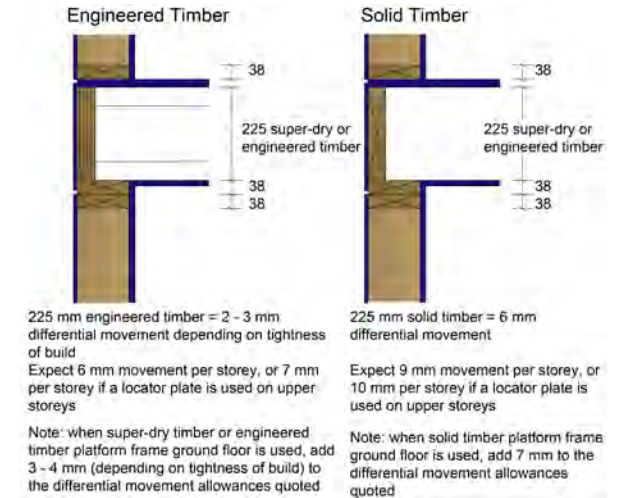
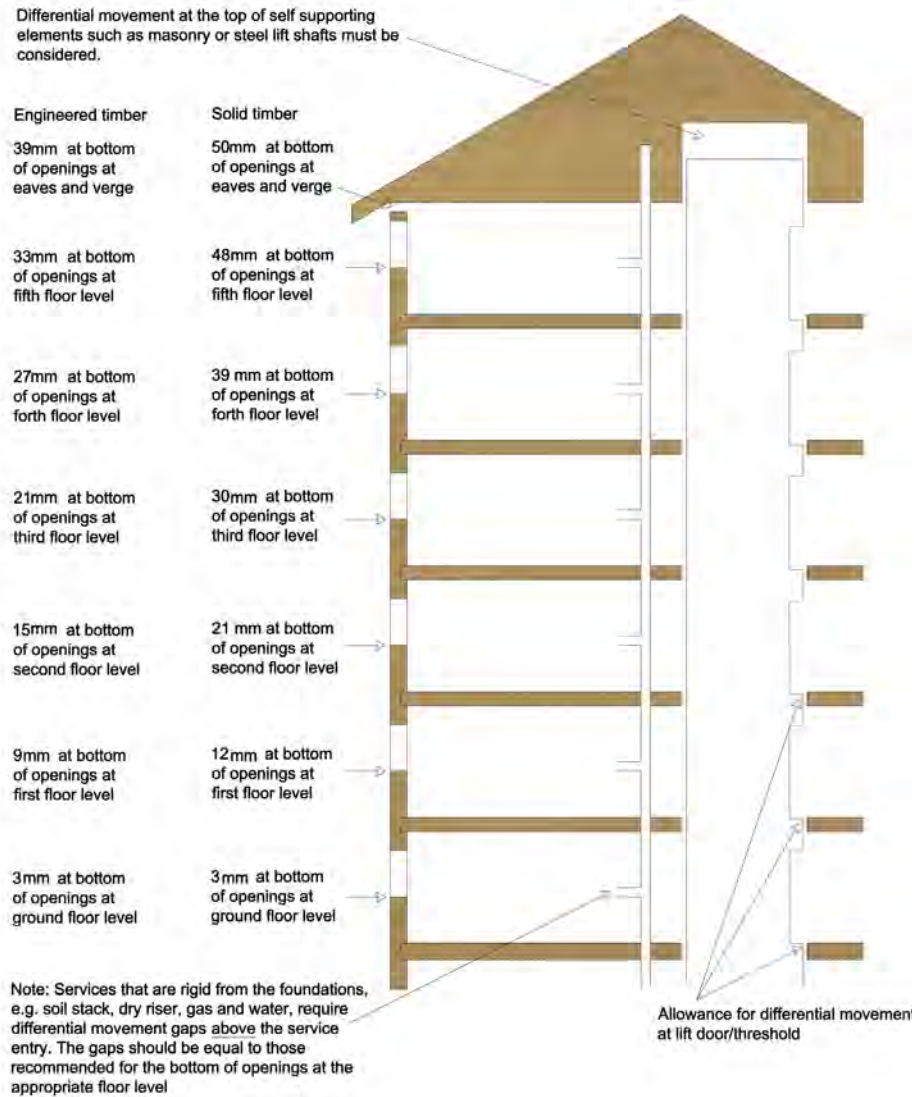


Figure 18: Differential movement at floor zones

Anticipated differential movement can be calculated using the allowance of 1mm for every 38mm of horizontal cross grain timber. As solid timber joists contribute significantly to anticipated differential movement, engineered timber joists should be considered where it is desirable to reduce differential movement.

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 the calculated gap size. Materials should be chosen to provide an effective weather tight seal dependant on whether they are to be subjected to compression, expansion or shear forces. Cover strips may also be used.

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**Self-supporting claddings (masonry)**

Any material or component attached to the timber superstructure that overhangs the brick or blockwork (e.g. cladding attached to the timber frame, window sills, roof eaves and verges) or projects through the masonry (e.g. balcony supports, flues, extractor fan vents or overflow pipes) should have a clear gap beneath and at the top of the masonry cladding to allow differential movement to take place, thus avoiding damage to the component or cladding.

The size of the gap should be calculated by allowing 1mm for every 38mm of horizontal cross grain timber present between the gap location and the lowest structural timber. Gaps will therefore increase in size up the building. The dimensions provided in Figure 19 should be used if site-specific calculations have not been provided.

Figure 19: Anticipated differential movement dimensions



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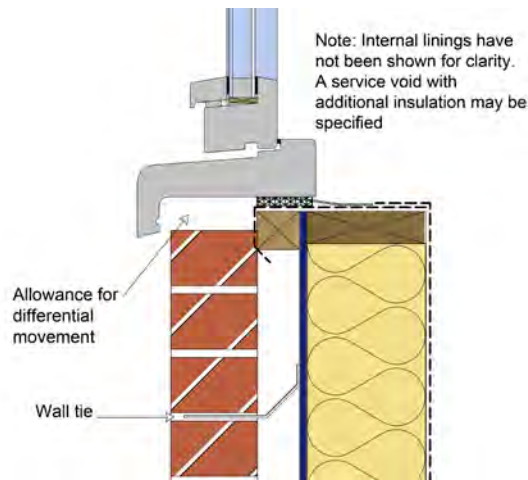


Figure 20: Differential movement gap

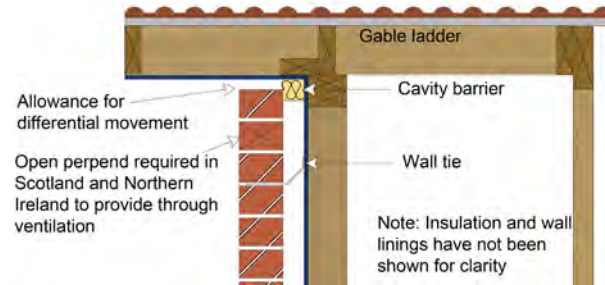


Figure 22: Differential movement at verge

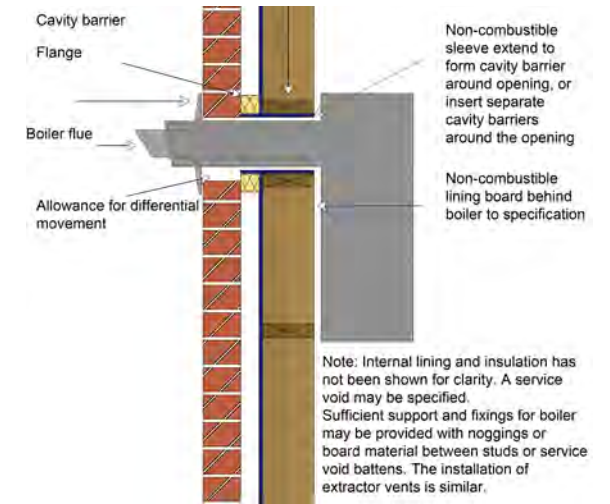


Figure 24: Differential movement at service penetration

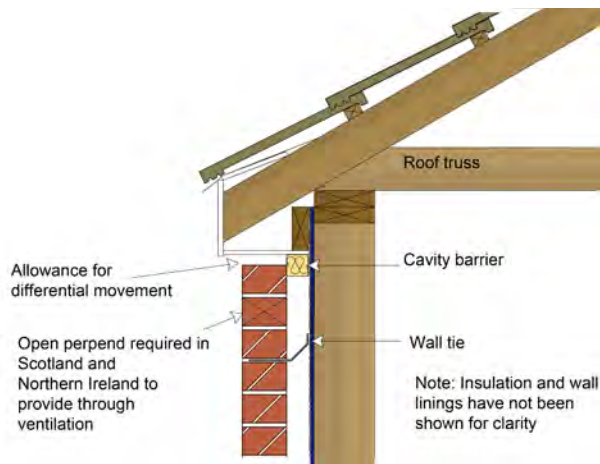


Figure 21: Differential movement at eaves

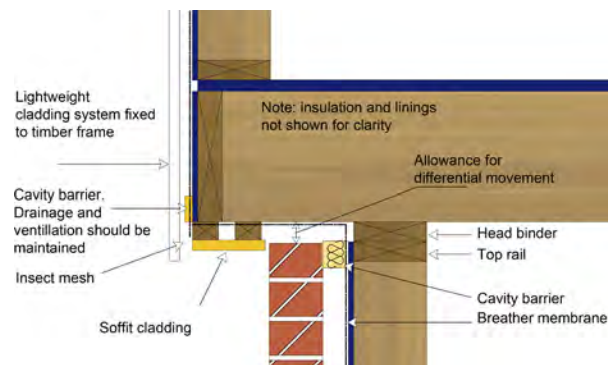


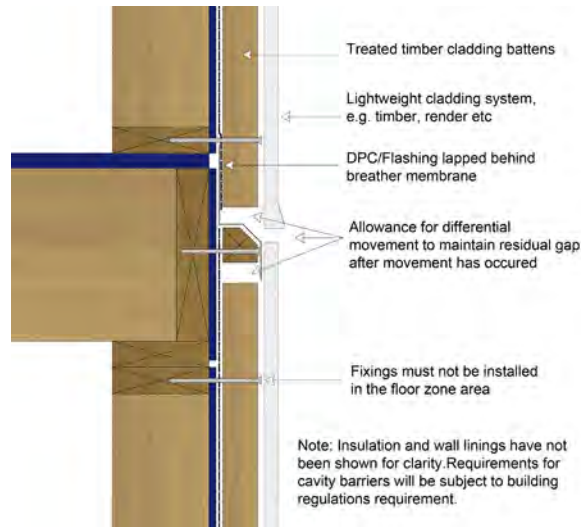
Figure 23: Differential movement at cantilevered overhang

Masonry cladding should not be supported on the timber frame structure.

Horizontal cross grain timber and construction gaps are concentrated at floor zones, and this is where the majority of movement occurs. 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. Unlike self-supporting claddings, movement is not cumulative but should be calculated individually for each floor zone using the formula above of 1mm for every 38mm of horizontal cross grain timber.



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**Figure 25: Differential movement at floor zone with cladding supported on timber frame**

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.

### Services

Rigid services within the timber frame structure also require an equal allowance for differential movement, as shown in Figure 19. Examples include copper gas and water pipes, dry risers, internal downpipes, SVPs and blockwork lift shafts. While gap allowances externally are allowed below, for example, a sill, when a branch comes off a rigid stack internally, the gap needs to be left above a service to allow the timber frame to drop around it.

### 7.3.6 References

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- BS 5268-3: 2006 Structural use of timber. Code of Practice for trussed rafter roofs.
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- BS 5268-6.1: 1996 Structural use of timber. Code of Practice for timber frame walls. Dwellings not exceeding seven storeys.
- BS 5268-6.2: 2001 Structural use of timber. Code of Practice for timber frame walls. Buildings other than dwellings not exceeding four storeys.
- BS EN 14081-1: 2005 Timber structures. Strength graded structural timber with rectangular cross section. General requirements.
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- BS EN 13986: 2006 Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking.
- BS EN 300: 2006 Oriented strand boards (OSB). Definitions, classification and specifications.
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- BS EN 622-4: 2009 Fibreboards – Specifications. Requirements for softboards.
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- BS EN 622-2: 2004 Fibreboards – Specifications. Requirements for hardboards.
- BS 4016: 1997 Specification for flexible building membranes (breather type).
- BS EN 845-1: 2003+A1: 2008 Specification for ancillary components for masonry. Ties, tension straps, hangers and brackets.
- EN 14732: 2011 Timber structures. Prefabricated wall, floor and roof elements. Requirements Draft for comment.