Chapter

# 11.2

# Closed Panel systems

**This chapter gives guidance on meeting the Technical Requirements for closed panel systems used to form homes where the height of the top floor above ground does not exceed 18m.**

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## Introduction

This chapter gives guidance on meeting the Technical Requirements for closed panel systems used to form homes where the height of the top floor above ground does not exceed 18m. For the purposes of this chapter, closed panel systems shall include:

- timber framed wall and floor panels
- light gauge steel framed wall and floor panels
- Structural Insulated Panel (SIPs) walls.

The guidance in this chapter does not apply to roof cassette systems or pre-manufactured panels formed from mass engineered timber, hot rolled steel or precast concrete. It also does not apply to use of the systems below ground level.

This chapter should be used in conjunction with Chapter 11.1 MMC systems: general requirements. This chapter seeks to focus on areas of guidance that are unique to the system type and method of construction employed, giving references to complimentary existing guidance provided elsewhere in the Standards where relevant.

There is a strong link to all chapters in Part 6 of the Standards, particularly Chapters 6.2, External time framed walls and 6.10, Light steel framed walls and floors.

The term 'Modern Methods of Construction (MMC)' is very broad and covers a wide range of differing offsite manufactured systems and onsite construction techniques.

MMC types have been categorised and defined in the MHCLG Joint Working Group 'MMC Definition Framework', see Chapter 11.1 MMC systems: general requirements. The scope of the guidance in this chapter will cover 'closed' panel systems that generally fall under Category 2 under the MMC Definition Framework and as defined below.

### Definitions of Open and Closed panel

MMC Category 2 light gauge steel and timber frame building systems are typically constructed from panels manufactured offsite under factory-controlled conditions. The extent of prefabrication can vary, with panels being as simple as studs and sheathing, or include external cladding, internal linings, windows and services. Where building systems utilise high levels of offsite prefabrication, traditional site inspection regimes for installation of critical materials, junctions and components are not possible. In addition, the greater the level of factory prefabrication, the greater the potential risks associated with exposure to moisture during construction.

Whilst the extent of offsite prefabrication can vary significantly, light gauge steel and timber frame building systems are typically categorised by NHBC as either 'open panel' or 'closed panel'. For the purpose of Warranty provision, NHBC's definitions are set out below.

### Open Panel

Flat two-dimensional panelised units fabricated offsite in a factory environment used to form wall and floor structures.

Open panel assemblies typically include:

- a structural frame of studs and joists
- floor decking and sheathing boards as required.

Additionally, open panel assemblies may also include:

- a fixed breather membrane to external walls
- insulation (between the studs only)
- a transparent air and vapour control layer (AVCL) in order that the construction/insulation can be viewed on site (note — if a non-transparent air and vapour control layer is used, the system will be considered by NHBC as being closed panel)
- battens forming a service zone
- temporary weather protection.

### Closed Panel

Closed panel systems are also defined as flat two-dimensional panelised units fabricated offsite in a factory environment used to form wall and floor structures, but in addition to the items set out above for open panel systems, where any one of the following items are factory fitted NHBC will consider the system to be closed panel:

- non-transparent air and vapour control layer
- sheathing boards to both sides of panels
- internal linings (such as plasterboard)
- continuous insulation installed to either the inner or outer face of the panels
- external cladding or finishes
- windows and doors
- fixed services such as plumbing pipes and electrical cables
- cavity barriers and/or fire stopping.

Guidance for traditional open panel construction formed from timber or light steel frame is given in Chapter 6.2 External timber framed walls and 6.10 Light steel framed walls and floors.

## Definitions for this chapter

| | |
|---|---|
| **Cavity** | A space enclosed by elements of a building such as the space between the cladding system and the backing wall. The external wall cavity should be adequately drained, and ventilated where required. |
| **Cavity barrier** | A construction within a cavity, other than a smoke curtain, to perform either of the following functions:<br>● close a cavity to stop smoke or flame entering<br>● restrict the movement of smoke or flame within a cavity. |
| **Closed panel** | Flat two-dimensional panelised units fabricated offsite in a factory environment used to form wall and floor structures, including where any one of the following items are factory fitted:<br>● non-transparent air and vapour control layer<br>● sheathing boards to both sides of panels<br>● internal linings (such as plasterboard)<br>● continuous insulation installed to either the inner or outer face of the panels<br>● external cladding or finishes<br>● windows and doors<br>● fixed services such as plumbing pipes and electrical cables<br>● cavity barriers. |
| **Factory installed** | An element of the construction that is placed, positioned, fitted, or secured in, on or as part of the unit as part of the factory construction process. |
| **Fire-stopping** | A seal provided to close an imperfection of fit or design tolerance between elements or components, to restrict the spread of fire and smoke. |
| **Floor cassette** | Flat two-dimensional panelised units fabricated offsite in a factory environment used to form a load-bearing element of floor construction. Typically includes a series of floor joists joined together with trimmers or end-joists and floor decking. |
| **Installation Manual** | Detailed installation guidance and information for the system compiled by the system manufacturer. The Installation Manual describes general instructions for storage and transport of the system, and procedures for on-site assembly and installation. |
| **Interface** | Interface either between similar or dissimilar envelope systems (eg at panel joints) or between envelope systems and other elements of the building (eg walls, roof, doors, and windows). |
| **Junction** | The point where components, including panels are joined with each other or with other elements of the building (eg supporting structure, roofs and foundations). |
| **Manufacturer** | The company which is responsible for the design and assembly of the closed panel system. |
| **Non-standard components** | Components that are assembled as part of the system but vary for individual projects. These may be windows, doors or services that may be built into the system. |
| **Primary structural components** | Elements of the structure designed to carry and transfer primary loads of the building, including self-weight, dead loads, and live loads. |
| **Secondary structural components** | Elements of the structure which do not play a wider role in the structure, but carry loads directly imposed on them (and transfer them to the primary structure) such as self-weight, wind loads, cladding and openings. |
| **Standard components** | Components that are assembled as part of the system and are common to all projects. |
| **System** | For the purposes of this chapter, this term refers to acceptable forms of closed panel systems. |
| **System Manual** | Detailed technical information on the system compiled by the system manufacturer. The System Manual describes the system, the declared performance of the system and evidence to support the declared performance. |
| **Unit** | A prefabricated building unit, manufactured offsite as a structural or non-structural assembly in three-dimensional or flat panel format used as part of a system to form the superstructure of a building. |

## 11.2.1 Compliance

*Also see: Chapters 2.1 and 11.1*

**Closed panel systems shall comply with the Technical Requirements.**

Closed panel systems that comply with the guidance in this chapter and associated chapters will generally be acceptable. This chapter should be used in conjunction with guidance in Chapter 11.1 MMC Systems: general requirements.

As many components of closed panel systems cannot be inspected on site, they should be treated as a building system as defined in Chapter 2.1, Standards and Technical Requirements and subject to assessment by an independent technical approvals authority or assessed under the NHBC Accepts service; **www.nhbc.co.uk/accepts**.

## 11.2.2 Provision of information

*Also see: Chapter 11.1*

**Designs and specifications shall be produced in a clearly understandable format, include all relevant information, and be distributed to all appropriate personnel.**

Design, specification and installation information should be issued to site supervisors, relevant specialist subcontractors and suppliers, and be made available on site to enable work to be carried out in accordance with the design. This should include:

- a System Manual (see Clause 11.1.3)
- clear, coordinated and fully detailed drawings providing sufficient information for construction and installation of the system
- a system Installation Manual (see Clause 11.1.9).

Refer to Chapter 11.1 MMC Systems: general requirements for further guidance.

## 11.2.3 Structural design

*Also see: Chapters 6.2, 6.3, 6.4 and 6.10*

**Closed panel systems shall be designed to support and transfer loads to foundations safely and without undue movement and shall have adequate resistance to loads imposed during manufacture, transportation, and installation.**

Closed panels should be securely fixed together and securely fixed to the floor and roof framing and surrounding construction.

Connections between closed panel and between closed panels and surrounding construction should:

- be designed to be structurally adequate
- include clear method of connection in the System Manual and Installation Manual
- be designed to avoid the risk of damaging or compromising the functional performance of factory installed elements such as breather membranes, AVCLs and lining boards.

### Closed panel timber frame

The design of structural walls should be in accordance with Chapter 6.2 External timber framed walls. Load-bearing internal walls should be designed in accordance with Chapter 6.3 Internal walls, and floors should be designed in accordance with Chapter 6.4 Timber and concrete upper floors.

### Structural insulated panels (SIPs)

The design of SIPs should be in accordance with the independent technical approvals authority certification. The scope of the certification should consider the design of a structure using the system, including panel connections and connections with other supporting elements such as intermediate floors, and not the panels in isolation.

Load-bearing internal walls should be designed in accordance with Chapter 6.3 Internal walls, and floors should be designed in accordance with Chapter 6.4 Timber and concrete upper floors.

### Closed panel light steel frame

The design of structural walls, structural floors and overall stability should be in accordance with Chapter 6.10 Light steel framed walls and floors.

### Temporary loads

Structural design of the units should consider the loads imposed during manufacture, storage, lifting and transportation and provide sufficient stiffness or protection against inadmissible deformation or deflection. See also Clause 11.1.8.

Where required, the design should specify temporary bracing and/or additional support arrangements for large openings or weak points in the structure and clearly identify the conditions under which such works can be removed.

## 11.2.4 Structural design checking and certification

*Also see: Chapters 6.2 and 6.10*

**The closed panel system shall be adequately designed and the design certified. Design of the superstructure shall be adequately checked by an NHBC registered certifier.**

### Closed panel timber frame

Structural design checking and certification should be in accordance with Clause 6.2.3.

### Structural insulated panels (SIPs)

Structural design checking and certification should be in accordance with Clause 6.2.3 where SIPs incorporate structural timber.

### Closed panel light steel frame

Structural design checking and certification should be in accordance with Clause 6.10.3.

## 11.2.5 Behaviour in relation to fire

**Closed panel systems shall have adequate fire resistance and resist the spread of fire and smoke. Issues to be taken into account include:**

1) **fire resistance of the unit or panel**
2) **cavity barriers and fire-stopping**
3) **services.**

Guidance within supporting documents to Building Regulations should be fully considered in the design and construction of closed panel systems.

The design and System Manual should clearly define:

- the overall fire protection strategy of the system
- which elements of fire protection are either factory or site installed.

### 11.2.5.1 Fire resistance of the unit or panel

Walls and floors should have adequate fire resistance in accordance with Building Regulations, supported with representative test evidence to appropriate standards.

The performance of specific details should be taken into account, including:

- fire protection to the structure around openings
- junctions between adjacent panels and interfaces of wall and floor panels
- compartmentation including interfaces with fire doors and junctions with adjoining building elements
- service openings, voids and penetrations.

**Structural insulated panels (SIPs)**
Lifting holes should be filled and sealed using a material providing the same level of protection as the material removed.

### 11.2.5.2 Cavity barriers and fire-stopping

The provision and installation of cavity barriers and fire-stopping should:

- be in accordance with Building Regulations and the design
- be designed to accommodate ventilation or drainage paths
- be used in accordance with manufacturers recommendations
- account for movement in the frame
- be specified to accommodate design, manufacturing and installation tolerances.

Moisture protection should be provided to horizontal and vertical cavity barriers.

Detailing and specification of cavity barriers and fire-stopping should be in accordance with the manufacturer's recommendations and supported with representative test evidence to appropriate standards.

### 11.2.5.3 Services

Only the services shown in the design should be installed in closed panel system floors and walls, and:

- service penetrations should not impair the fire resistance of floors and walls
- service mains should not pass through separating wall cavities.

## 11.2.6 Acoustic performance

*Also see: Chapters 6.2, 6.3, 6.4 and 6.10*

**Closed panel system walls and floors shall have adequate resistance to the passage of sound.**

Separating walls and floors should be in accordance with Building Regulations. In England, Wales, and Northern Ireland, separating walls and floors may be built in accordance with Robust Details 'Resistance to the passage of sound' as an alternative to pre-completion sound testing.

Separating walls and floors should be in accordance with the design. Care should be taken to avoid gaps:

- between mineral wool quilt or batts
- between internal lining board layers
- between cavity barriers
- around openings for services.

Internal walls should be in accordance with Clause 6.3.7

**Proprietary partitions**
Closed panel systems when used as proprietary partitions should be independently assessed or tested for 'sound transmission' performance in compliance with Technical Requirement R3.

## 11.2.7 Differential movement

*Also see: Chapters 6.2 and 6.10*

**Buildings formed using closed panel systems shall account for differential movement between the frame wall and other building elements or supporting structures.**

Where closed panel systems connect to surrounding construction and differential vertical movement is expected, consideration should be given to:

- accommodation of suitable movement joints in self-supporting and lightweight claddings
- the design of joint details and accommodation of differing floor levels at thresholds at staircases and lift shaft enclosures
- service entries, risers and fixed vertical external services
- design and provision of suitable weather resistant and durable joints
- interface of self-supporting cladding and cladding attached to the unit
- design of connection brackets, anchors, and ties to accommodate movement.

Where claddings are factory installed and supported by the panel, consideration should be given to interfaces with self-supporting cladding.

**Closed panel timber frame**
The design for differential movement in closed panel timber frame structures should be in accordance with Clause 6.2.8.

**Structural insulated panels (SIPs)**
SIPs not incorporating structural timber should be designed in accordance with the manufacturer's recommendations.
The design for differential movement in SIP structures incorporating structural timber should be in accordance with Clause 6.2.8.

**Closed panel light steel frame**
The design for differential movement in closed panel light steel frame structures should be in accordance with Clause 6.10.20.

## 11.2.8 Protection from moisture

*Also see: Chapters 5.1, 6.1, 6.2, 6.10 and 11.1*

**Closed panel systems shall be adequately protected from the effects of moisture. Details of closed panel systems at low level shall fully consider the durability of materials, protection of the building from moisture ingress and condensation as a result of thermal bridging. Issues to be taken into account include:**

1) **cavities in external walls**
2) **protection at low level**
3) **DPCs, DPMs and cavity trays**
4) **junctions between adjoining panels.**

Guidance on temporary weather protection can be found in Clause 11.1.5. Guidance on moisture management strategies for structural timber buildings can be found in Structural Timber Association publication 'Moisture management strategy'.

### 11.2.8.1 Cavities in external walls

A clear cavity in accordance with Table 1 should be provided between the cladding and insulation.

**Table 1:** Minimum cavity widths

| Cladding | Cavity width |
|---|---|
| Masonry | 50mm |
| Render on board background | 25mm |
| Vertical tile hanging [1] where a breather membrane is provided and fixed to sheathing | Dependant on batten support layout and spacing[1] |
| Other cladding [1] | See Chapter 6.9 Curtain walling and cladding |

Notes
1. See Chapter 6.9 Curtain walling and cladding.

Cavities should be:

- drained (for light steel frame walls)
- extend at least 150mm below DPC
- drained and vented (for timber frame and SIP walls)
- be kept clean, free from obstructions and capable of draining freely.

**Closed panel timber frame walls**
Cavities to closed panel timber frame walls should be in accordance with Clause 6.2.10.

**Structural insulated panels (SIPs)**
Cavities to SIP walls should be in accordance with Clause 6.2.10.

**Closed panel light steel frame walls**
Cavities to closed panel light steel frame walls should be in accordance with Clause 6.10.16.

### 11.2.8.2 Protection at low level

**Closed panel timber frame and structural insulated panels (SIPs)**
The lowest timber should be a minimum of 150mm above finished ground level. This may be reduced to 75mm in situations where the site is not subject to a high water table or where the cavity will not have standing water.

DPCs should be installed below the sole plates of walls and ground floor internal partitions.

Where external ground levels are raised locally to accommodate accessible entrances, consideration should be given to the following:

- appropriate drainage installed along the perimeter or ground falling away from the building
- adjacent surface finishes which do not promote splashing
- additional cavity ventilation either side of raised ground levels
- use of a 'kerb' or 'upstand' to raise level of timber frame elements.

**Closed panel light steel frame**
The protection of light steel frame at low level should be in accordance with Clause 6.10.16.

### 11.2.8.3 DPCs, DPMs and cavity trays

Damp proofing should:

- be installed correctly to provide a physical barrier to the passage of water, and to ensure water is directed to the outside
- use only appropriate tapes and sealant (but not solely rely on sealant) in accordance with the design and manufacturer's recommendations
- use DPCs/DPMs where necessary, including junctions between systems and any other component or systems.

**DPCs**
The following materials are acceptable for use as DPCs:

| | |
|---|---|
| **Bitumen-based materials** | BS 6398, BS EN 14967 |
| **Polyethylene (except as cavity trays in walls, below copings and in parapets)** | BS 6515, BS EN 14909 |
| **Proprietary materials** | Technical Requirement R3 |
| **Thermoplastics and Elastomers** | BS EN 14909 |

**DPMs**
Where DPMs are required, they should be linked with any DPCs in the supporting structure, in order to provide continuous protection from moisture from the ground or through the supporting structure.

DPMs should be properly lapped in accordance with Chapter 5.1 Substructure and ground-bearing floors.

Suitable materials for DPMs include:

- 1,200-gauge (0.3mm) polythene sheet
- minimum 1,000-gauge (0.25) polythene sheet where assessed in accordance with Technical Requirement R3
- bitumen sheet to BS 6398
- proprietary materials assessed in accordance with Technical Requirement R3.

### Cavity trays

Cavity trays should be provided at all interruptions to the cavity (eg window and door openings and air bricks) and abutments unless otherwise protected (eg by overhanging eaves) or alternative means of protection are provided (eg profiled metal flashings) such as part of a proprietary cladding system.

Clause 6.1.17 contains further guidance on the installation of cavity trays in masonry cladding.

The following materials are acceptable for use as cavity trays:

- plastic and rubber to BS EN 14909 and hold satisfactory assessment by an appropriate independent technical approval's authority accepted by NHBC
- proprietary materials as part of a cladding system holding satisfactory assessment by an appropriate independent technical approvals authority accepted by NHBC.

## 11.2.8.4 Junctions between adjoining units

At junctions between closed panel systems or between closed panel systems and surrounding construction, particularly where they incorporate factory installed external claddings, consideration should be given to:

- providing suitable access to seal laps of breather membranes and AVCLs and achieve minimum vertical and horizontal laps
- providing suitable access to adequately link DPCs and DPMs in the substructure
- use of appropriate tapes and sealant (but not solely rely on sealant) in accordance with the design and the manufacturer's recommendations
- design of suitable cladding joints in accordance with the manufacturer's recommendations
- interaction of cavity barriers and cladding joints
- use of damp proofing materials which are compatible with adjoining components.

Connections between closed panel systems and between closed panel systems and surrounding construction should be designed to avoid the risk of fixing through and thus puncturing or damaging AVCLs or breather membranes.

## 11.2.9 Insulation

*Also see: Chapters 6.2 and 6.10*

**Insulation shall be suitable for the intended use, correctly installed, and be of a suitable material and thickness to comply with Building Regulations and reduce the risk of surface and interstitial condensation.**

Insulation should be:

- in accordance with the design
- installed correctly to minimise the risk of thermal bridging, surface, and interstitial condensation
- installed in accordance with the manufacturer's recommendations.

The System Manual and design should include control measures to mitigate risk of slump of non-rigid insulation during transport and site installation.

Where insulation is to be installed to the external/cavity face of the frame, workmanship and tolerances of external walls, particularly at panel joints, should be maintained to minimise the risk of:

- reducing the width of clear cavities
- gaps between insulation boards
- ledges between insulation boards forming moisture traps.

### Closed panel timber frame

Insulation to closed panel timber frame walls should be in accordance with Clause 6.2.15.

### Structural insulated panels (SIPs)

Insulation to SIPs should be assessed as part of current certification by an appropriate independent technical approvals authority accepted by NHBC, as an integral part of the wall system.

### Closed panel light steel frame

Insulation to closed panel light steel frame walls should be in accordance with Clause 6.10.17.

## 11.2.10 Junctions and interfaces

*Also see: Chapters 6.2 and 6.10*

**Junctions and interfaces shall be suitably detailed, built to appropriate tolerances and provide satisfactory performance.**

The use of closed panel systems, particularly where finished linings or claddings are installed may introduce junctions and interfaces between adjoining units that are not common in traditional construction.

The junctions of panels should be designed with appropriate tolerances to avoid excessive deviation:

- to external faces of adjacent panels, which may impact cavity widths, installation of insulation and cladding as well as performance of cavity barriers or fire-stopping
- to internal faces of adjacent panels, which may impact continuity of acoustic or fire-resisting linings or installation and fit of surrounding construction (eg staircases).

The manufacturer and designer should consider:

- guidance on jointing methods for structures, claddings, openings, and services passing through building elements given in BS 6093
- undertaking of mock-ups or trials to ensure satisfactory fit and tolerances can be achieved.

### Closed panel timber frame

When fixing closed panel timber frame walls to the substructure, they should be installed in accordance with the manufacturer's design and Clause 6.2.4 and 6.2.5.

### Closed panel light steel frame

When fixing closed panel light steel frame walls to the substructure, they should be installed in accordance with the manufacturer's design and Clause 6.10.10.

### Floor cassettes

The design should clearly specify where connections are required to provide lateral restraint or robustness at floor to wall junctions. Installation instructions should be given in the System Manual and Installation Manual. Where floor cassettes incorporate permanent floor decking, care should be taken to design cassette junctions at thresholds or intermediate walls to minimise large joints in open rooms.

Adjoining cassettes should be securely fixed to ensure structural continuity and to avoid differential deflection in accordance with the manufacturer's design.

Junctions between decking to adjoining floor cassettes should be designed to achieve necessary tolerances to allow installation of floor coverings. Interfaces of decking may either be designed as a butt joint or by using a transition piece to accommodate minor tolerances between decking finishes.

Cassette junctions should:

- have a nominal 3mm gap at decking joints
- filled with an appropriate gap filler or covered with a cover strip
- be kept clear of debris
- not exceed 2mm level difference between floor decking at any position.

### Foundations

Foundations should be installed to tolerances in accordance with the System Manual. The foundation tolerances should consider:

- level of foundation
- straightness of foundations
- dimensional tolerance
- level between foundation and substructure brickwork
- squareness of foundations.

## 11.2.11 Cladding

*Also see: Chapters 6.1, 6.2, 6.9, 6.10 and 9.1*

**External claddings shall be suitable for their intended purpose, have suitable junctions and interfaces to resist the penetration of water and wind, be suitably durable and have an acceptable finished appearance. Issues to be taken into account include:**

1) **junctions and interfaces between cladding types and adjoining units**
2) **movement**
3) **continuity of insulation, breather membranes and AVCLs**
4) **tolerances**
5) **finished appearance.**

Masonry external cladding should be in accordance with Chapter 6.1 External masonry walls.

Lightweight external claddings, whether factory or site installed, should be:

- in accordance with Chapter 6.9 Curtain walling and cladding
- compatible with the framing system
- supported by systems assessed in accordance with Technical Requirement R3 which ensure that cladding design loads are effectively and safely transferred to the building structure.

Further guidance on render onto board backgrounds can be found in Clause 6.11.8.

The design and construction of cladding to external walls should consider:

- cavity drainage
- differential movement
- restraint
- performance in relation to fire
- durability.

**Closed panel timber frame and structural insulated panels (SIPs)**
Further guidance on the use of masonry and lightweight claddings with closed panel timber frame and SIP walls can be found in Chapter 6.2 External timber framed walls.

**Closed panel light steel frame**
Further guidance on the use of masonry and lightweight claddings with closed panel light steel frame walls can be found in Chapter 6.10 Light steel framed walls and floors.

### 11.2.11.1 Junctions and interfaces

Junctions and interfaces, including those between factory installed lightweight cladding systems to adjoining panels, and those between lightweight cladding systems and other elements of the building, should be carefully designed and detailed to be weather resistant, and prevent moisture reaching parts of the wall it could adversely affect.

The design should take account of:

- differing profile characteristics
- movement
- design of suitable interfaces between differing cladding types
- tolerances and deviation
- the erection sequence.

For lightweight cladding finishes applied to an insulation backing, the use of small infill pieces at panel junctions or differing types of backing insulation (eg to form cavity barriers or fire-stopping at compartment lines) should be detailed in accordance with the manufacturer's recommendations and within the scope of certification by an independent technical approvals authority acceptable to NHBC.

### 11.2.11.2 Movement

Movement joints to masonry cladding should be in accordance with Clause 6.1.3. Refer to Clause 6.2.8 for further guidance on accommodating movement in masonry cladding to timber frame structures, and Clause 6.10.20 for masonry cladding to light steel frame structures.

**Lightweight claddings**
Where lightweight or self-supporting cladding is used movement joints should be provided where required by the design.

Movement joints should be:

- formed in accordance with the cladding system manufacturers recommendations
- positioned to accommodate calculated movement
- continued through the depth of the cladding.

Accommodation of differential movement should be made at floor zones between lightweight cladding.

## 11.2.11.3 Continuity of insulation, breather membranes and AVCLs

Junctions and interfaces of adjoining panels or panels with surrounding construction should be carefully designed and detailed to ensure continuity of insulation, breather membranes and AVCLs.

The design should:

- ensure adequate laps of membranes or provision for a suitable method of sealing in accordance with the manufacturer's recommendations
- make allowance for secure fixing of insulation, including at panel junctions, to the support frame or wall.

## 11.2.11.4 Tolerances

Where factory installed lightweight claddings extend to the edges of panels, the cladding interfaces should meet the following tolerances unless specified otherwise by the design:

- be adequately straight in elevation, with a maximum ± 6mm deviation from the nominal design width in any unit edge width or height up to 3m (see Figure 1)
- a maximum of 5mm from plumb or level in the overall interface joint between units (see Figure 2)
- a maximum deviation of 6mm in plan or section between faces of adjoining units (see Figure 3)
- a maximum deviation of 6mm in elevation between in-line edges across a transverse or cruciform interface joint (see Figure 4).

Figure 1: Straightness of interface joint widths

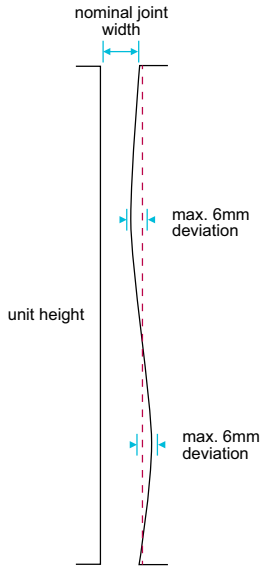



Figure 2: Taper of interface joints

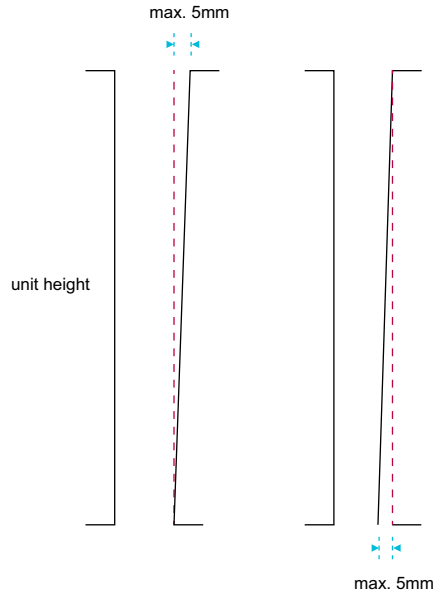


Figure 3: Offset of cladding faces

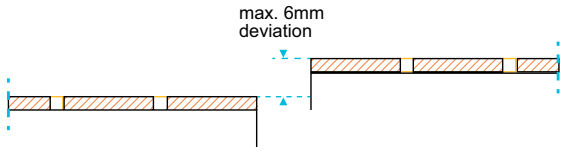
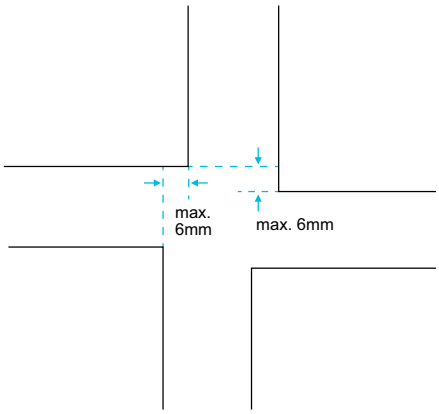



Figure 4: Accuracy of cruciform interface joints




### 11.2.11.5 Finished appearance

Tolerances and finishes for factory installed external claddings should be in accordance with Chapter 9.1 A consistent approach to finishes.

#### Brick slip cladding

Factory installed brick slip claddings should be set out to co-ordinate with adjacent panels and surrounding construction to avoid:

- cutting of brick slips, particularly in the storey heights, at corners, around openings, and at panel edges except when it is essential
- irregular or broken bonds of brick finishes, particularly at openings
- small cuts of brick finishes
- broken bond and out of line joints at junctions of panel and junctions with surrounding construction (eg substructure brickwork).

Care should be taken to ensure the finish specification of mortar used for site installed brickwork is the same as used for factory installed brick slip claddings to avoid variation in the texture, finish, and colour.

#### Weatherboard cladding

Factory installed weatherboard cladding should be set out to co-ordinate with adjacent panels and surrounding construction to avoid:

- cutting and notching cladding boards around window and door openings
- misaligned cladding boards at panel junctions.

## 11.2.12 Doors, windows, and glazing

*Also see: Chapter 6.7*

**Doors, windows, and glazing shall comply with the Technical Requirements and be designed and specified to ensure adequate in-service performance.**

Doors, windows, and glazing should be designed, specified, and installed in accordance with Chapter 6.7 Doors, windows and glazing.

The specification of fixings for doors and windows should be adequate to resist the effects of vibration and loads imposed during storage, transport and installation.

Adequate protection against damage should be provided to factory installed doors and windows, particularly where protruding from the face of the panel.

## 11.2.13 Air and vapour control layers

**Air and vapour control layers shall be designed and installed correctly to restrict the passage of water from within the home to the structural frame.**

A high resistance air and vapour control layer should be provided, unless a condensation risk analysis shows that it is not necessary, and the air and vapour control function is being provided by another solution compliant with NHBC Technical Requirements. Modelling where appropriate should be undertaken in accordance with BS EN ISO 13788 or BS EN 15026. The following boundary conditions should be used for the purposes of calculation to BS EN ISO 13788:

- at 21ºC internally
- at -2ºC externally
- >60% internal RH.

Where they are provided, AVCLs should be:

- sealed around service penetrations
- 500g polyethylene sheet, vapour control plasterboard, or material assessed in accordance with Technical Requirement R3
- in accordance with the design
- overlapping the base rail
- fixed on the warm side of the wall insulation and frame
- placed to cover the external wall, including base rails, head rails, studs, lintels, and window reveals
- taped or sealed in accordance with the manufacturer's recommendations and punctures made good.

Air and vapour control layers should be:

- stapled at 250mm centres to the top and bottom of the frame, at laps and around openings to closed panel timber frame
- fixed with double-sided tape or adhesive as a temporary fixing before the wall board is fixed to closed panel light steel frames.

Joints in air and vapour control membranes should:

- have 100mm minimum laps
- be located on studs or noggings.

Where vapour control plasterboard is used:

- joints between sheets should be positioned on studs or noggings
- joints should be filled, taped, and finished
- care should be taken not to displace the vapour control material when cutting vapour control plasterboard.

Where internal linings or sheathing boards are factory installed to panelised units, provision should be made to allow adequate access to achieve correct lapping and sealing of vapour control layers at junctions when installed in the final position on site.

Multiple layers of AVCL-type material through the thickness of the element should be avoided, except where condensation risk analysis shows it to be acceptable.

### Closed panel timber frame and structural insulated panels (SIPs)

For closed panel timber frame systems and SIPs, where they incorporate structural timber, all structural timber elements (including the OSB of the SIP, if applicable) should have a moisture content of less than 20% before any internal AVCLs, insulation or plasterboard linings are installed.

## 11.2.14 Breather membranes

**Breather membranes shall be correctly installed to protect the sheathing and frame from external moisture, and capable of allowing vapour to pass into the cavity.**

Breather membranes should be:

- 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
- at least Class W2 to BS EN 13859-2 with no water leakage during testing. In areas of very severe exposure (see Clause 6.1.6 for classification of exposure zones) or where liquid water penetration of the cladding is anticipated, for example open-jointed cladding, Class W1 should be used. When open-jointed claddings are used or the membrane likely to be left exposed during construction for a duration longer than normally to be expected (also see the membrane manufacturers recommendations on exposure times), performance should be based on artificial aged behaviour in accordance with BS EN 13859-2. Where a vented and ventilated cavity with full rainscreen and no gaps, for example masonry or rendered board claddings, are used, performance should be based on artificial aged behaviour in accordance with BS EN 13111
- self-extinguishing
- fixed so that vertical joints are staggered where possible, and at regular intervals, to prevent damage by wind
- installed so that each joint is protected, and moisture drains outwards
- lapped so that upper layers are over lower layers to ensure rain runs away from the sheathing
- lapped to a minimum of 100mm at horizontal joints and a minimum of 150mm at vertical joints
- fixed at a maximum spacing of 600mm horizontally and 300mm vertically
- fixed at a maximum spacing of 150mm around openings
- marked with stud positions for wall tie fixing
- applied using austenitic stainless-steel fixings
- repaired or replaced before proceeding with the cladding, if damaged
- durable and adequately strong when wet, to resist site damage
- capable of resisting water penetration.

For panelised systems without studs such as SIPs, fixings to the breather membrane should be at regular centres and suitably spaced at openings and panel edges.

### Closed panel light steel frame

Breathable membranes should be used to protect sheathing boards and insulation. Breather membranes may be omitted where water resistant insulation boards with taped joints are used. Tape should be of a type recommended by the insulation manufacturer, breathable to allow water vapour to move freely and resist water penetration. Suitable taping should be applied at the lintel interfaces and other penetrations to direct water outside.

## 11.2.15 Sheathing boards

*Also see: Chapters 6.2 and 6.10*

**Sheathing boards shall be durable and suitable for their intended purpose.**

Sheathing boards should be:

- of a suitable strength and quality
- compatible with the frame
- attached using suitably specified and durable fixings.

Sheathing boards contribute to many functions critical to the performance of the system and building and cannot be easily replaced, so should comply with Technical Requirement R3.

### Closed panel timber frame

Sheathing boards to closed panel timber frame walls should be in accordance with Clause 6.2.7.

### Closed panel light steel frame

Sheathing boards should be appropriate for the exposure of the building and suitable for use in humid conditions.

Sheathing boards to closed panel light steel frame walls should be in accordance with Clause 6.10.20.

## 11.2.16 Wall ties

**Wall ties and fixings shall adequately connect the cladding to the frame.**

Wall ties and their fixings should be:

- compliant with BS EN 845-1
- fixed to studs and not the sheathing
- in accordance with and of the type specified in the design
- of austenitic stainless steel or assessed in accordance with Technical Requirement R3
- kept clean and free from mortar droppings
- inclined away from the sheathing so that the slope is maintained following differential movement
- capable of accommodating differential movement
- installed at a minimum density of 3.7 ties/m$^2$ for masonry cladding, eg spaced at a maximum of 600mm horizontally and 450mm vertically
- spaced at jambs of openings and at movement joints at a maximum of 300mm vertically and within 225mm of the masonry reveal or movement joint; additional studs may be needed
- spaced within 225mm of the top of the wall, including at gables.

### Structural insulated panels (SIPs)

Where wall ties are fixed directly to the outer sheathing layer, screw fixings should be used. The pull-out strength of screw fixings should be:

- tested, or
- designed in accordance with relevant standards.

## 11.2.17 Services

*Also see: Chapters 6.2 and 6.10*

**Internal services shall not adversely affect the stability or performance of the panel and be adequately protected from damage.**

Service mains and service outlets should be:

- designed to ensure the fire resistance of walls and floors is not impaired
- designed to ensure that the required sound insulation of walls and floors is maintained
- installed in accordance with the design
- on the warm side of the insulation
- designed to accommodate differential movement where required.

### Closed panel timber frame

Services to closed panel timber frame walls should be in accordance with Clause 6.2.9.

### Structural insulated panels (SIPs)

Services passing through SIPs should not adversely affect the fire performance of the building. Issues to be taken into account include:

- suitable detailing of services passing through panels
- location and type of firestops to be used
- integrity of walls and floors.

Where holes are required to accommodate services, this should only be carried out in accordance with the manufacturer's recommendations or be designed by an engineer in accordance with Technical Requirement R5.

When installing services to SIPs, they should:

- be planned in advance so that ducts and conduits are provided
- not be chased into the core of the panel
- be installed in such a way to avoid cutting, igniting, or damaging the panel
- have additional engineered designed support for heavy loads from central heating and ventilation systems, or kitchen appliances.

### Closed panel light steel frame

Services to closed panel steel frame walls should be in accordance with Clause 6.10.22.

## 11.2.18 Further information

- *Structural Timber Association — Moisture management strategy*

## Technical Disclaimer

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