2.7 Application of panels in structural wall sheathing

2.7.1 Selection of panels for sheathing

2.7.1.1 Performance considerations

The selection of board type depends on an overall assessment of wall performance including:

- strength and stability
- durability
- thermal performance
- interstitial condensation risk
- the possible effects of moisture in service
- whether the sheathing is to be positioned to the inside or the outside of the framing
- other components in the wall e.g. vapour control layers, insulation type and thickness, breather membranes, cavity barriers.

Strength and stability

Sheathing is primarily used to provide racking resistance and stiffness to a framed structure. Plasterboard and other internal lining boards can also contribute to racking resistance.

In timber-framed structures sheathing boards are usually applied to the outside of the framing where they also act to provide an early dry envelope to the building, and contain and protect any insulation during construction. Permanent weather protection is usually provided by exterior cladding.

When sheathing boards are applied internally to the frame the advantages of early enclosure may be lost but board properties of strength, durability and abrasion resistance may be used to provide durable linings, for example in agricultural or industrial buildings, subject to the application of an appropriate flame spread treatment if required.

Durability

The durability of wood-based boards depends on the species of timber used, the adhesives used to bind the fibres or particles together, and the conditions of use, in particular with regard to wetting and risk of decay.

The species generally used in wood-based boards are considered to have non-durable heartwood and, in any case, would include a high proportion of sapwood which is itself perishable.

The adhesives can have improved moisture resistance, dependent on formulation, and can be modified to include waxes or resins to improve water and weather resistance.

Where boards are used as structural sheathing the boards are generally at risk of wetting during initial erection and over the remainder of the building process until the cladding is complete. These conditions are unlikely to lead to the prolonged excessive moisture contents which can lead to the onset of decay.

Boards however may occasionally be at risk from wetting in service due to building defects. Choice of the correct type and grade of board will reduce the consequences of poor design or workmanship in such situations.

There are no requirements for preservative treatment of any wood-based structural sheathing. Where wood-based boards are used as sheathing on the outside of framing the specifier should take account of the degree of exposure and the type of cladding when deciding what type of preservative, if any, should be specified.

Thermal performance

Framed walls using fibreboards, OSB, plywood, CPBB or particleboard sheathing are ideally suited for the inclusion of insulation in the space between the studs.

The U-value (thermal transmittance) of a wall depends on its overall construction including sheathing material type, insulation thickness and cladding. Typical examples for timber framed walls (with all voids filled with mineral wool or cellulose fibre insulation and allowing 15% for the framing) would be as follows:

90mm studs - 0.42W/m^2k
140mm studs - 0.30W/m^2k
195mm studs - 0.22W/m^2k

If the rigid foam insulation, with a λ value not greater than 0.02W/mk, is used these figures become:

90mm studs - 0.27W/m^2k
140mm studs - 0.19W/m^2k
195mm studs - 0.15W/m^2k

If rigid foam insulation is used, care is required to cut the insulation accurately to fit each cavity. Any gaps could result in cold bridges with potential for surface condensation.

These low values make timber frame wall construction ideal for providing excellent thermal performance using proven technology; conventional construction can easily meet building regulation requirements.

Moisture in service and condensation risk

When wood-based panels are used as sheathing fixed to the outside of insulated framed wall panels the internal lining must have higher vapour resistance to control interstitial condensation risk within the wall panel. This is typically obtained by incorporating a separate polyethylene sheet vapour control layer or a plasterboard with integral vapour control layer on the warm (room) side of the insulation. Any wall construction should meet the requirements of BS 5250 which now refers to EN ISO 13788 as the method of calculation.

When used as sheathing fixed to the inside of insulated framed wall assemblies, panels with higher vapour resistance e.g. OSB, may have sufficiently high vapour resistance to act as an adequate vapour check and remove the need for a separate vapour control layer. The outer layers of construction must have low vapour resistance compared to the inner layers to allow the wall to breathe. Condensation risk should be assessed by calculation in accordance with BS 5250 which now refers to EN ISO 13788 as the method of calculation.

Breather membrane fixed over the external face of wall panel assemblies can be used to stop water ingress at panel or assembly joints to protect the panels from wetting and to improve airtightness. Breather membrane should always be used with particleboard, OSB, plywood and mediumboard sheathing fixed to the outside of framing, but is not needed with impregnated fibreboards or cement bonded particleboards, unless these materials are used on buildings in areas of severe exposure. The breather membrane should have low vapour resistance (<5.7MNs/g) to reduce any possible interstitial condensation risk.

Where no breather membrane is used it is recommended that joints between wall panel assemblies are taped to stop water ingress and to improve airtightness; panel to panel joints do not need to be taped.

Figure 2.16 shows an insulated timber framed wall with wood-based sheathing fixed to the outside of the framing, covered with a breather membrane and clad with brickwork fixed with flexible ties.

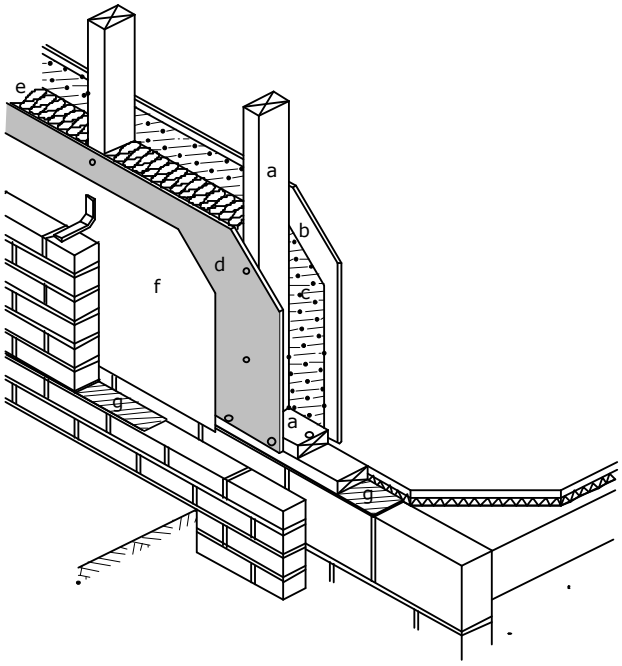

Figure 2.16 Typical timber frame external wall construction
a: stud framing
b: internal lining
c: vapour control layer
d: sheathing on outside face of wall frame
e: insulation
f: breather membrane (when required)
g: damp proof course

2.7.1.2 Board selection

Given the performance requirements detailed in the previous section the selection of wood-based panels must be made from the list given in Table 2.12.

2.7.2 Design of structural sheathing

The various factors to be incorporated in design together with the three alternative design concepts were set out in Section 2.2.

For a particular set of conditions, defined in terms of design, load and environmental conditions, long-term experience and test work has demonstrated compliance of the design with specified requirements. These designs, or values of racking resistance to be used in design, are **deemed to satisfy** and BS 5268-6: Section 6.1 (Table 2) gives the racking resistance for certain thicknesses of plywood, particleboard, OSB and CBPB.

In those situations where the "deemed to satisfy" approach is inapplicable, recourse must be made to either designing by prototype testing, or by calculation as set out in Table 2.9 and Section 2.2.

Typical board sizes are 2400 x 1200mm and 2400 x 600mm, with other sizes available to order. Sizes up to 3660mm high are available to allow fabrication of wall panel assemblies for increased storey heights or which can accommodate floor joists. The usual board width is 1200mm to suit typical framing centres of 400 and 600mm.

TABLE 2.9 PANEL GRADES* FOR TIMBER FRAME SHEATHING AND THE LOCATION OF DESIGN AND TESTING INFORMATION

	TIMBER FRAME	SERVICE CLASS	PLYWOOD EN 636	PARTICLEBOARD EN 312	OSB EN 300	MDF EN 622-5	FIBREBOARD EN 622-3,4	CBPB EN 634
Selection	**Sheathing**	2	636-2	P5	OSB/3	-	SB.HLS MBH.HLS1 MBH.LS2 HB.HLA2	CBPB

Design by Deemed to satisfy	✓	"Deemed to satisfy" performance values for racking resistance are given in BS 5268-6: Section 6.1 (Table 2) for Category 1 boards such as plywood, particleboard, OSB and CBPB.

or

Design by performance testing	✓	Test using EN 594 and EN 596. Satisfy the requirements in BS 5268-6: Section 6.1. Design using BS 5268-6: Section 6.1.
	or	Test using EN 594 + EN 596. Satisfy requirements in EN 12871. Design using EN 1995-1-1 (Eurocode 5).

or

Design by calculation	✓	use BS 5268-6: Section 6.1
	or	use EN 1995-1-1 (Eurocode 5)

Guidance on application	✓	Guidance on the use of load-bearing boards in sheathing is given in BS 5268-6: Section 6.1 and in DD CEN/TS 12872.

* The table provides the minimum grade of panel that satisfies the particular set of requirements: panels of higher quality may be substituted, and their selection may result in a reduction in required thickness.

Although all the panels meeting the grade specifications will satisfy a particular set of requirements, the level of performance of different brands of these panels may vary considerably, some may even be endowed with high levels of properties not directly covered by the table.

2.7.3 Sitework

2.7.3.1 Conditioning

It is important that in the construction of wall units either on site or in the factory, individual boards are fixed at a moisture content close to that which they will achieve in service. Advice on the conditioning of boards is to be found in Section 4.2.4 of PanelGuide.

2.7.3.2 Wall panel assembly

Sheathing can be used in wall panel assemblies made either on- or off-site, or in 'stick-built' construction assembled on site.

2.7.3.3 Planning and cutting

Stud spacings need to be related to sheathing and lining board widths, for ease of fixing and to avoid cutting sheets unnecessarily, and are commonly at 400mm or 600mm centres. Openings can be formed by cutting sheets to fit around the framed openings or cutting the required opening in a sheet already fixed to the opening framing. Such openings need to be accounted for in the design calculations.

2.7.3.4 Assembly

Sheathing boards, except softboard fixed to the outside of framing, should have gaps of 3mm between adjacent sheets to accommodate possible expansion due to moisture content increase. Softboard should be tightly butted.

Sheathing boards fixed to the inside of framing should be tightly butted except in the case of OSB.

All boards should have all edges supported by and fixed to a framing member with minimum bearing of 18mm for the board edge. Boards at panel edges should normally be flush with framing member edges, to ensure adequate anchorage and give protection to the framing from the weather. It is good practice to tape or gasket panel joints where there is no breather membrane.

2.7.3.5 Fixing

Boards should be fixed using corrosion resistant nails, staples or screws. Corrosion resistant materials include galvanised or sheradised steel, austenitic stainless steel, phosphor bronze and silicon bronze. NHBC and Foundation 15 have particular requirements for the material specification for nails and staples.

Minimum nail length should be 50mm or 2.5 times the board thickness, whichever is greater.

Staples should have as wide a crown as possible – 11mm minimum, be not less than 15 gauge and not less than 50mm in length.

The frequency and pattern of nailing around the periphery and on intermediate studs is given in Table 2.10 and shown in Figure 2.17, and this should be followed unless structural calculations are based on test results, in which case the nailing schedules used in construction should use the same nailing pattern as tested. Where manufacturer's instructions are supplied with the boards their recommendations should be followed. To avoid tear out at board edges, fixings should not be inserted closer to the edges than the minimum distances given in Table 2.10.

With the thinner and more flexible boards, to avoid buckling, nailing should commence at the top centre and continue outwards and downwards.

Table 2.10 Spacings of fixings in sheathing

Panel type	Maximum spacings (mm)		
	Perimeter framing	Intermediate framing	Min edge distance (mm)
Softboard	75	150	8
Mediumboard	150	300	8
Hardboard	150	300	9
Particleboard	150	300	8
Cement bonded particleboard*	150	300	8
OSB	150	300	8
Plywood	150	300	8

* Boards may need to be pre-drilled or fixed with self-drilling screws to avoid splitting

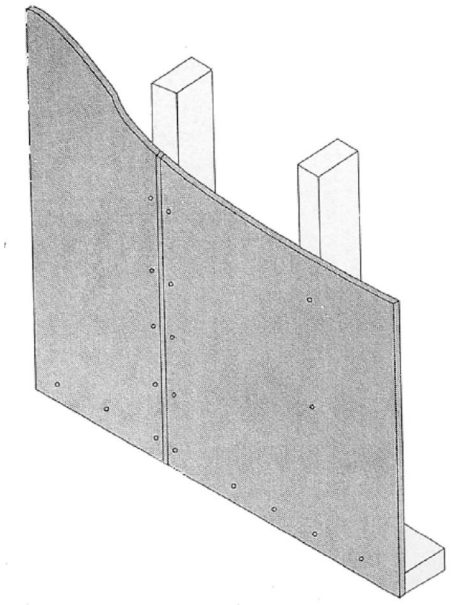

Figure 2.17 Typical sheathing board fixings
Minimum edge distance 8mm. Centres of intermediate fixings are generally twice the perimeter fixing centres (see Table 2.10)

2.7.3.6 Handling and storage of fabricated wall panel assemblies

Where boards are used to form structural wall panel assemblies which are then transported to site from the point of fabrication it is recommended that the following precautions are taken during storage and erection of the panel assemblies so that they are used in the best possible condition:

transport:
- protect with waterproof coverings during transport
- finished panels should be fully supported
- edge protection is needed to avoid banding or strapping damaging board edges.

storage:
- panel assemblies should be stored on raised bearers to prevent contact with the ground or with vegetation
- panel assemblies should be fully supported to prevent distortion, sagging or twisting
- panel assemblies may be stored horizontally or vertically. If stored horizontally they should be placed with the sheathing face uppermost to avoid collection of water within the panels
- panel assemblies should be protected from rain saturation.

handling:
- care needs to be taken during lifting to avoid distortion/twisting of panels, straining of fixings and joints, and damage to edges
- when panels are lifted by crane, use guide ropes to stop excessive sway and to assist in locating panels
- panels should not be used as 'ladders' to provide temporary access to upper storeys.

2.7.3.7 Erection of panel assemblies

Panel assembly framing should only be notched, cut or drilled if carried out in accordance with the recommendations of BS 5268-2. Small holes or openings through the sheathing should be framed to support all edges.

Panel/panel nailing and on-site nailing of sheathing to framing should follow nailing schedules.

If wall panel assemblies are damaged during storage, handling or erection it is recommended that damaged sheets are not patched over but are either partly replaced using appropriate framing to support cut board edges or completely replaced. In the case of serious damage then consult a qualified structural engineer.

Framed wall panel assemblies with fibreboard, particleboard, CBPB, OSB or plywood sheathing can be clad with a range of materials including brickwork, render on stainless steel mesh, rendered blockwork, tiles or slates, profiled metal sheet, timber boarding, exterior fibreboard and particleboard cladding, or proprietary wood panel products.

All claddings should incorporate a vented drained cavity between the cladding and the outside of the wall panel assemblies (see Figure 2.16).

Battens for tile-hanging or other claddings should be fixed through the sheathing to the framing, not to sheathing alone. Where horizontal battens are fixed for tiles or slates, they should be fixed to vertical battens nailed through to the studs – the vertical battens provide a ventilated cavity.

Wall ties for brick or block cladding should be strip ties of austenitic stainless steel, phosphor bronze, or silicon bronze, and should be flexible to allow for differential movement between the structure and the cladding. The ties should be fixed through external sheathing to the stud framing.

Cement bonded particleboard, tempered hardboard, exterior structural plywood and OSB may also be used to act as combined sheathing and cladding in appropriate situations. Careful consideration should be given to joint details and any paint or finishing systems. Where boards are used as combined sheathing/cladding on insulated wall panels the condensation risk of any paint or finishing system needs to be carefully assessed.