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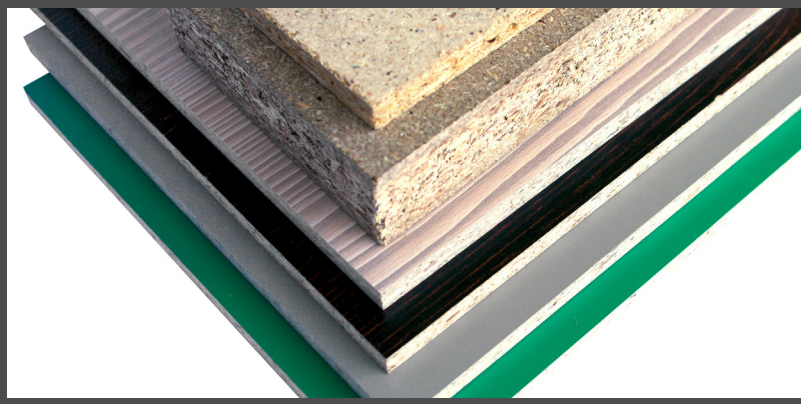
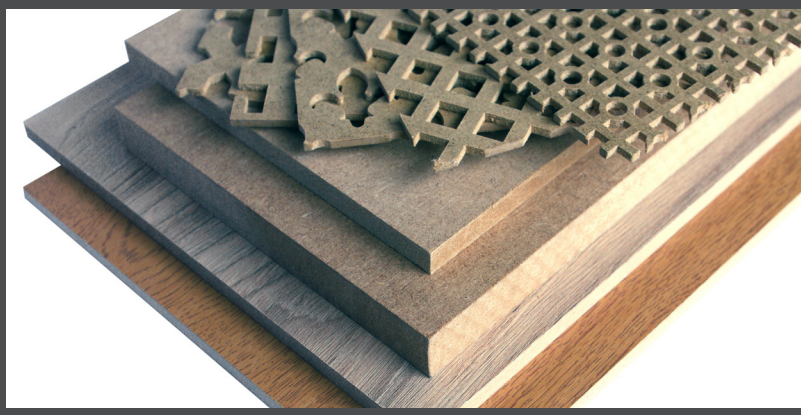
# Panel Guide

## Version 4







# 4 Storage, handling, cutting, fixing and finishing

## 4.1 General

Correct handling and transportation of wood-based panels is essential to prevent either damage to the panels or injury to the persons undertaking these operations. It is therefore important that the correct storage, transportation and handling techniques described in *Section 4.2* and *Section 4.3* are employed. Likewise, incorrect cutting and machining can damage the panels or cause injury to the operative. All Health and Safety guidelines must be adhered to when working with wood-based panels, and assistance in this regard is given in PanelGuide *Section 6*. The correct methods for cutting and machining are described in *Section 4.4*.

Being reasonably durable and resilient, most wood-based panels can withstand a certain amount of wear and tear, but lack of care before and during construction can have an adverse effect. In addition to the strength of the panels, the surface appearance can be an important feature of the finished structure. Proper storage, transportation, handling and installation will ensure that the final performance and appearance is as intended.

As a natural material, wood contains moisture and the amount held within it varies with the temperature and relative humidity of the surrounding environment. Wood-based panels are no different from solid wood in this respect and their moisture content will change with changes in relative humidity and temperature. Changes in moisture content result in changes in mechanical properties and in dimensions (length, width and thickness).

It is therefore important that the moisture content of a panel is as close as possible to its final in-service moisture content at the time of installation. In addition, wood-based panels must be given sufficient protection throughout the construction process to ensure final in-service moisture content is maintained. This will, to a large extent, minimise the risk of any in-service distortion problems.

The mechanical properties of wood-based panels also vary with moisture content and in structural applications it is essential that they are installed in the environment for which they have been designed. The moisture resistance of wood-based panels varies with product type, according to the specification, and again the use of a product in the wrong Service Class could lead to poor performance or premature failure.

Further guidance in relation to correct installation and fixing is provided in *Section 4.5* and in relation to decoration and finishing in *Section 4.7*.

## 4.2 Storage and transportation

Correct storage is important for all wood-based panels. Care is needed to avoid mechanical damage to panel edges and corners and to avoid damage from wetting or high humidity.

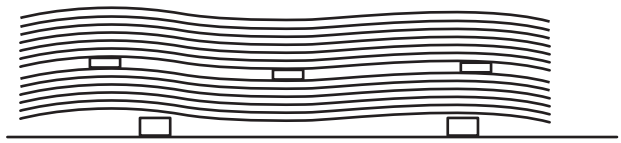
### 4.2.1 Stacking

Panels should be stacked flat on a level surface with all four edges flush. The panels should be sufficiently clear of the ground to avoid any potential splashing from water on the ground. Stacking of panels on edge should be avoided, whenever possible. The ideal base for the stack is a close boarded or slatted pallet. If this is not possible, then the panels should be carefully stacked on battens of equal thickness at centres not exceeding 600mm, as shown in *Figure 4.1*.

Where thin panels (6mm or less) are being stacked, it is recommended that they are supported under the whole area of the panels by a thicker panel (≥18mm).

Intermediate bearers are recommended every 10 to 15 panels to allow through ventilation. If used, each layer of batten must be placed directly above those in the layers below. The battens should be placed parallel to the short edges of the panels, with ends equidistant from the long edges. Overhang of the panels at the edges and ends of the stack should not exceed 150mm at any point. Where palletised stacks are placed on top of one another, bearers should line up to prevent distortion.


a



b

**Figure 4.1: Panel storage**
a – correct
b – incorrect (can result in panel damage and deformation)

Where space will only permit stacking on edge, then the edges should not be permitted to come into direct contact with the ground or floor to avoid any possible moisture pick-up or damage to the edges. Panels should not be leant against walls but should be supported by a braced, purpose-made stack using thick (>18mm) base and back panels (see *Figure 4.2*). Edge stacking is not recommended for cement-bonded particleboards.

The top of the stack should be covered with a protective panel to counteract any tendency for the top panel to warp and to protect the stack from mechanical damage.

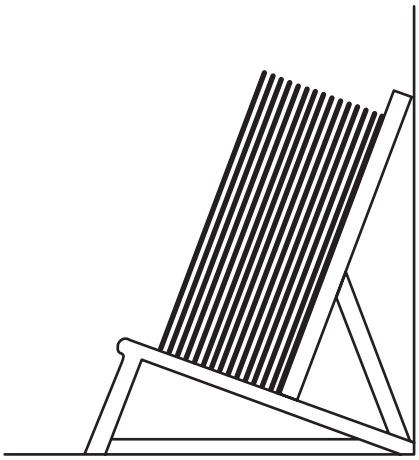


**Figure 4.2: Correct method of edge stacking**

If panels are to be stacked outside, they should be fully protected by a waterproof covering (see *Section 4.2.3*).

Detailed information on the safe stacking of sawn timber and panel materials is given in the HSE information sheet *Stacking round timber, sawn timber and board materials*[1], which includes information on stacking packs and the storage of panels in racks.

### 4.2.2 Protection during transport

Panels should be adequately protected during transportation by a waterproof covering. Edges should be well protected from rain, traffic spray or other water and measures taken to reduce the risk of water being blown up under the stack.

Edge protection should be provided to avoid damage by ropes, straps or other banding. This is particularly important with profiled panels, such as tongued and grooved (T&G) flooring. Panels should be fully supported to prevent distortion.

Where panels are banded, the bands should be cut as soon as practicable after delivery in order to prevent them from causing permanent damage to the panels. This is a particular problem if panels are stored in a humid environment, as they can expand due to moisture uptake.

When packs are delivered with edge or face protection boards, these should be left in place until the panels are required for use.

### 4.2.3 Storage on site

Stacking of panels on site should be in accordance with the recommendations given above.

Panels must be protected from rain and direct wetting at all times. They should ideally be stored in an enclosed building but where a short period of external storage is unavoidable, then stacks should be well covered with opaque, waterproof sheeting. The stacks should be placed on bearers to keep the underside clear of the ground and any vegetation. Measures should be taken to avoid the risk of splashing of the underside of the stack.

Any protective wrapping should be left in place for as long as possible and only removed when the panels are required for conditioning.

### 4.2.4 Conditioning

Timber and wood-based panels expand on taking up moisture from the surrounding air and shrink on losing moisture. Wood-based panels are manufactured to close dimensional tolerances and excessive changes in moisture content can lead to dimensional changes that can cause problems, such as bowing, in service.

In order to minimise the risk of this occurring, the moisture content of panels at the time of installation should be as close as possible to the in-service moisture content. Panels are normally manufactured at low moisture contents, between 2% and 13%, and may still be very dry at the time of delivery.

Where panels are to be used in warm dry areas, it is important that the moisture content of the panels is kept as low as possible. This requires storage in an internal, dry environment that is preferably heated. Any protective wrapping should be left in place until shortly before installation. If the storage conditions are close to the final in-service conditions, then the panels can be unwrapped and conditioned by loose-laying (on floors) or horizontal stacking with spacers between each panel (following the stacking principles in *Section 4.2.1* and *Figure 4.1*). A minimum conditioning period of 48 hours is recommended but longer periods may be required, depending upon the conditions required and the initial moisture content of the panels.

For some types of panel, conditioning with water is used as a way of increasing the panel moisture content and to encourage expansion before fixing. This is used on some types of hardboard and mediumboard, particularly where they are to be used in unheated or damp conditions. It is important that this is only carried out in accordance with the manufacturer's recommendations, but the normal procedure for doing this is to lay the panels smooth side down on a flat, clean surface in an unheated, draught-free place, under cover and out of direct sunlight. The back (mesh) face of each panel is wetted with a brush or clean mop using approximately 1 litre of clean water. The panels should be uniformly wetted working from the centre outwards. The panels should then be stacked back to back for 48 to 72 hours depending upon the material type and the manufacturer's recommendations.

## 4.3 Handling

### 4.3.1 General

When lifting, moving and stacking panels, edge protection should be provided to avoid damage by lifting ropes and/or forklift tines.

When handling pre-finished panels, it is essential to avoid damage or dirt on the finished surfaces. Pre-finished panels should be lifted from the stack and not slid.

**Table 4.1: Typical weights of some common panels**

| Panel type | Thickness | Typical panel weight (kg) for given panel sizes (mm) | | |
|---|---|---|---|---|
| | (mm) | 610 × 2440mm | 1220 × 2440mm | 1220 × 3660mm |
| **Particleboard** | 15 | 14 | 29 | 43 |
| | 19 | 18 | 36 | 55 |
| | 25 | 24 | 48 | 72 |
| | 32 | 31 | 61 | 92 |
| **Flaxboard** | 15 | 10 | 20 | 30 |
| | 19 | 13 | 26 | 38 |
| | 25 | 17 | 34 | 50 |
| | 32 | 21 | 42 | 62 |
| **CBPB** | 12 | 21 | 42 | 63 |
| | 16 | 29 | 58 | 87 |
| | 22 | 39 | 78 | 117 |
| **MDF** | 12 | 14 | 28 | 42 |
| | 15 | 17 | 35 | 52 |
| | 19 | 22 | 44 | 66 |
| | 32 | 37 | 75 | 112 |
| **OSB** | 18 | 17 | 34 | 51 |
| **Hardboard** | 6 | 9 | 17 | 26 |
| **Softwood plywood** | 9 | 8 | 15 | 22 |
| | 15 | 12 | 25 | 37 |
| **Hardwood plywood** | 9 | 10 | 19 | 28 |
| | 15 | 16 | 30 | 45 |

In the case of manual handling of panels, compliance with the relevant health and safety recommendations should be maintained at all times. This includes wearing appropriate Personal Protective Equipment (PPE) such as suitable gloves and safety shoes. In case of any doubt, guidance can be sought from the UK Health and Safety Executive (HSE). HSE recommends a maximum manual lifting weight at knuckle height of 25kg. In relation to the maximum safe lifting weights, some typical weights of common panels are given in *Table 4.1*.

# 4.4 Cutting and machining

## 4.4.1 General

All wood-based panels can be cut or machined by hand or with power tools, but with any such activities, care has to be exercised to avoid injury to the operator or damage to the material and equipment. It is important that operatives have a clear understanding of the operation, follow any manufacturer's specific guidance for their product, and adhere to relevant health and safety guidelines. PanelGuide *Section 6* 'Health and safety' provides generic guidance of the hazards that may be encountered and techniques which can be employed to minimise risk.

When cutting wood-based panels, it is important to pay attention to normal woodworking best practice. Sharp cutters, adequate support close to saws and cutters, elimination of machine vibration, correct allowance for saw kerf etc will all help to ensure that a good result is achieved in a safe fashion.

The quality of cut on a panel is affected by moisture content and therefore where a close fit is an essential requirement, panels should be cut to size after conditioning to their final in-service moisture content. Such panels must then be given sufficient protection throughout the construction process to maintain this in-service moisture content.

## 4.4.2 Cutting with hand tools

All panel types can be cut to size with conventional hand tools, although some types, for example cement-bonded particleboard (CBPB), are more difficult to cut than others and cutting edges may need regular maintenance. While satisfactory results can be achieved using hand tools, quicker and more consistent results can be achieved using either portable or fixed power tools.

## 4.4.3 Machining with power tools

Fixed workshop machines are generally most appropriate for cutting and machining wood-based panels, as they provide a better quality finish and allow health and safety requirements to be effectively addressed, particularly in terms of machine guarding, dust extraction and manual handling. Hand-held power tools are generally only appropriate to small volumes of in-situ cutting or final adjustment on site. The rate of feed should generally be slower than that used for natural timber and cutting edges should be kept sharp.

A variety of tooling systems are available for the cutting and machining of wood-based panels ranging in price from standard steel through tungsten carbide tipped (TCT) blades to polycrystalline diamond tipped (PCD). High energy laser beams can also be used for intricate pattern cutting in most types of wood.

Tungsten carbide tipped (TCT) blades are the most common system because of their longer cutting life. Tungsten carbide tipped saws and cutters have a much lower rate of wear than most other types and this offsets their higher initial cost. Polycrystalline diamond tipped (PCD) tools have improved resistance compared to tungsten carbide tools. However, due to their high initial cost their use is generally limited to high volume production.

As the grain directions of the wood particles in fibreboards and particleboards are random, saw blades with cross cutting forms should be used. Certain types of cutter (portable circular saws and jigsaws) cut on the upstroke, and the wanted or decorated face should therefore be placed facing downward (see *Figure 4.3*). Bench circular saws, on the other hand, cut on the down stroke and necessitate feeding in the panel face uppermost.

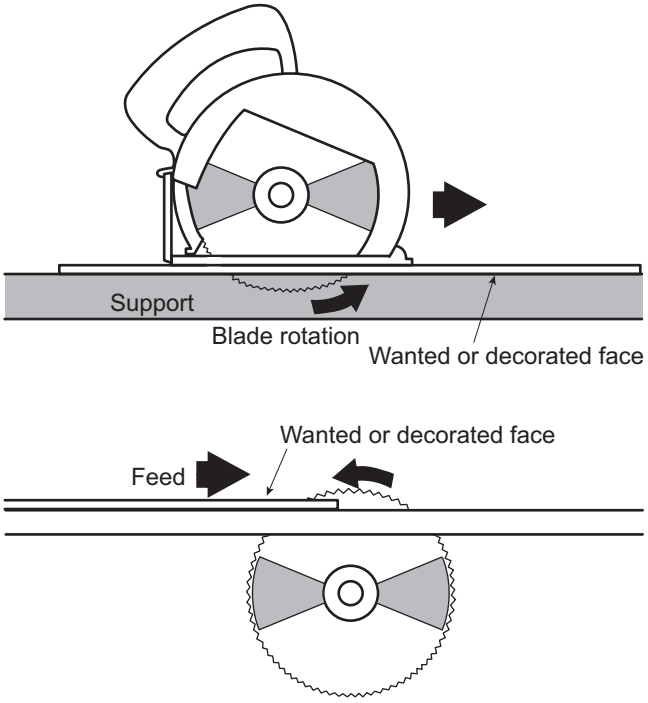



**Figure 4.3: Sawing wood-based panels**

Circular saw blades should be set as low as possible to prevent chipping and scoring as the panel passes the rear of the saw blade. The height of the saw blade should be positioned so as to maintain the correct hook angle relative to the panel surface (see *Figure 4.4* and *Figure 4.5*). The projection of the saw above the panel has a direct influence on the cleanliness of the cut. Breaking out or chipping of the top surface will occur if it is insufficient and on the bottom if it is too great. If either occurs, the projection should be adjusted accordingly until the defect disappears. If the fault is persistent then the saw speed should be increased or the rate of feed reduced.

If the feed speed is too slow, cutters will have insufficient chip load and the tip of the cutter will wear rapidly. Too great a feed speed will result in rough fibrous cut edges. Control of the panel during machining is important; panels should be properly supported and pressed down firmly against the cutting table and guides to avoid vibration.

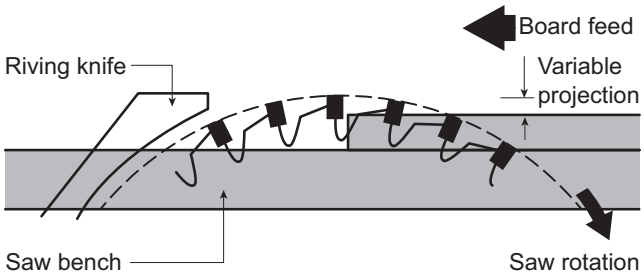



**Figure 4.4: Saw blade setting**

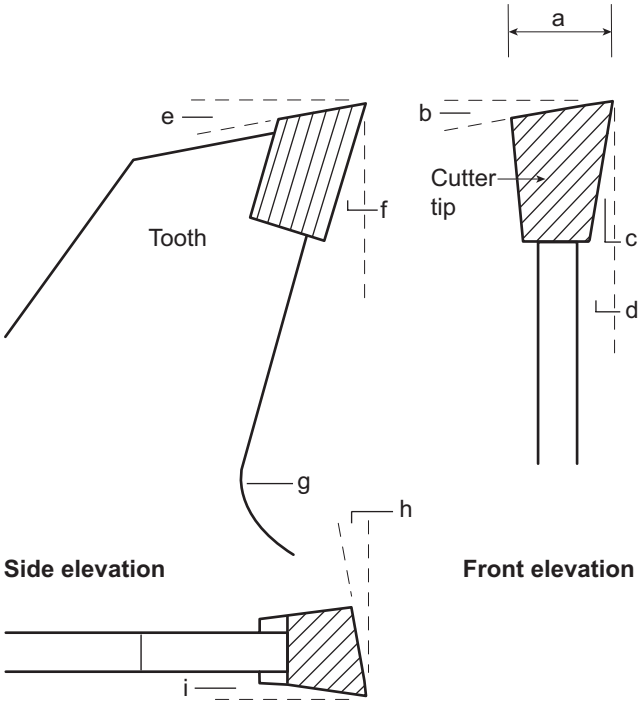



**Figure 4.5: Saw blade nomenclature**
a) kerf, b) back bevel angle, c) radial clearance, d) tip to body clearance, e) clearance angle, f) hook (rake) angle, g) gullet, h) front bevel angle, i) side (tangential) clearance

## 4.4.4 Requirements for different panel types

### 4.4.4.1 Softboard

***Cutting and sawing***

For softboard up to 19mm thick the most convenient method is to use a trimming knife against a straight edge. To reduce tear-out on the reverse face, the cut should be made onto a flat, rigid backing material. Panels of 19mm or more in thickness should be cut with a fine-toothed hand or power saw.

***Routing***

Softboard can be cut with a router using normal wood cutting bits but may not give a clean edge.

***Drilling***

Use a normal hand drill or power drill and bits designed for drilling wood.

***Sanding***

Sanding is not normally required but softboard can be face or edge sanded by hand or with orbital sanders. Profiled edges are generally not achievable on softboard.

### 4.4.4.2 Hardboard and mediumboard

***Sawing***

Hardboard and mediumboard can be cut with a hand saw or powered circular saws, band saws and jigsaws. To prevent chipping, hand saws with 10 or more teeth per 25mm are recommended, held at a low angle of cut to the panel and with minimum tooth set. *Table 4.2* gives guidance on the saw settings (refer to *Figure 4.5* for terminology).

**Table 4.2: Recommendations for saws**

| Saws | |
|---|---|
| **Diameter (mm)** | 350 |
| **Revs per minute** | 3500 to 4000 |
| **Cutter speed (m/sec)** | 70 |
| **Number of teeth** | 75 |
| **Feed speed (m/minute)** | 20 to 50 |
| **Chipload (mm)** | 0.19 |
| **Back clearance angle** | 10° to 14° |
| **Hook or rake angle** | 5° to 10° |
| **Tangential clearance angle** | 3° |
| **Radial clearance angle** | 1° |
| **Front bevel angle** | 0 to 5° |
| **Back bevel angle** | 10° to 15° |

***Spindle and routing***

Hardboard and mediumboard can be routed and moulded using conventional woodworking tools and bits. PDT and TCT cutters should be used. Cutters must be kept sharp as dull cutters will cause edges to 'bell' or spread, causing difficulties with laminating, edging or lipping. General feed speeds should be slower than for solid timber, and cutters should have the largest number of cutting edges possible (see *Table 4.3*).

**Table 4.3: Recommendations for spindle moulders**

| Spindle moulder | |
|---|---|
| **Revs per minute** | 6000 |
| **Cutter speed (m/sec)** | 30 to 50 |
| **Number of teeth** | 6 to 8 |
| **Feed speed (m/minute)** | 8 to 10 |

***Drilling***

For drilling hardboard and mediumboard, drill bits designed for drilling steel are more suitable than those intended for other wood-based materials. Speeds of 3000 to 4000 rpm produce the cleanest cut with least lipping around the hole. Conventional steel drills have bits with a point angle of 118°, increasing this angle to 170° helps to decrease surface lipping (see *Figure 4.6*).

***Sanding***

Face sanding should not be necessary; edge sanding may be done by hand or with orbital or belt sanders.

### 4.4.4.3 Dry process fibreboards (MDF)

***Sawing***

MDF can be sawn with a hand saw or power saws, TCT blades are recommended. Saw blades developed for particleboards will cut MDF with reasonable success but the adoption of alternative top bevels of 15° and an increased tip clearance angle of 20° and 22° will extend saw life between sharpening operations (see *Figure 4.5*).

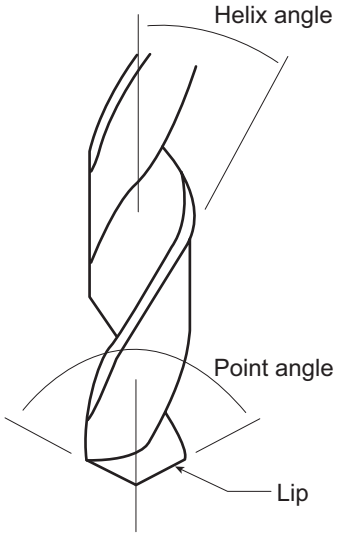



**Figure 4.6: Twist drill nomenclature**

Chipload should be in a range 0.15 to 0.25mm. When using a 40-tooth saw blade, irrespective of diameter, operating at 3000 rpm, feed speed should be in the range 18m/minute (0.15 chipload) to 30m/minute (0.25mm chipload).

The saw geometry in *Table 4.4* has been found to give satisfactory results.

**Table 4.4: Suitable saw geometry for cutting MDF**

| MDF | |
|---|---|
| **Top bevel angle** | 15° alternative |
| **Side clearance** | 2° to 4° |
| **Tip to body clearance** | 0.25mm to 0.45mm |
| **Clearance angle** | 20° to 22° |
| **Hook angle** | 15° |

***Routing***

MDF can be routed and moulded to very accurate and highly finished profiles. TCT cutters should be used. Cutters must be kept sharp as dull cutters will cause edges to 'bell' or spread, causing difficulties when laminating, edging or lipping.

Router cutters generally incorporate cutting angles in the range 15° to 25° and clearance angles in the range 15° to 18°.

***Drilling***

MDF can be drilled using all types of woodworking drill bits.

***Sanding***

The faces of MDF are usually pre-sanded by manufacturers with 120 grit abrasive. This provides a smooth surface ideally suited to the direct application of most veneers and plastic foils. Scuff sanding with the object

of increasing adhesion may be detrimental. For the economic application of paints or printed effects and for very thin foils a further light sanding with 200 grit abrasive may be advisable.

Excessive sanding of the faces should be unnecessary and because it could unbalance some MDF panels it should be avoided. Silicone carbide abrasives are generally recommended for sanding MDF. Aluminium oxide abrasives tend to dull rapidly, producing burnishing. A 'modified closed coat' abrasive is suggested. High sanding speeds cut the fibres most effectively; for example, with belt sanders, belt speed in excess of 1500 metres per minute is recommended.

Sanding after moulding or routing produces a smoother surface, moulded edges can be sanded using a profiled sander. 80/100 grit abrasives should be used to remove cutter marks, 120/150 grit is required for finish sanding.

### 4.4.4.4 Particleboard and flaxboard

***Sawing***

Particleboard and flaxboard can be sawn with normal hand tools or with a power saw using a TCT (or similar hard tipped) blade. Bench saws should preferably have blades of 350mm to 450mm diameter with 75 or 96 teeth. Tooth shape should be in accordance with the saw manufacturer's recommendations. Feed speed should not exceed 15 metres per minute. Projection of the blade above the work surface should normally be between 8mm and 20mm.

***Spindle and router***

Use TCT cutters. The cutter spindle speed should be 18000 to 24000 rpm and the material feed rate 4.5 to 9 metres per minute.

The edges of particleboard panels can be 'planed' and/or profiled on a spindle machine but the profile should be kept simple to reduce the risk of break out. Feed speeds should be slower than for solid timber and the maximum number of cutting edges provided. The values in *Table 4.5* are suggested.

***Drilling***

Drill speed and angle of the drill point should be the same as used for natural wood.

**Table 4.5: Settings for spindle and router for cutting particleboard**

| | |
|---|---|
| **a) Spindle** | |
| **Speed** | 4000 to 6000 rpm |
| **Cutter block** | Minimum 4 cutters |
| **Cutters** | Toe: 42°<br>Heel: 45° |
| **Feed speed** | 4 to 5 metres per minute |
| **b) Router** | |
| **Speed** | 1800 to 2400 |
| **Cutters** | Double-edged bit, min 25mm cutting edge ground to angle of 53° |
| **Feed speed** | 4 to 5 metres per minute |

***Sanding***

Particleboards are supplied with a sanded finish; sanding is normally necessary only as a finishing process after machining or the fabrication of a component. Where the edge of the particleboard is required as a finished face and the saw cut edge is unsatisfactory, sanding is the preferred method. For finishing work a 120–200 grit abrasive should be used depending upon the degree of smoothness required. Excessive sanding of the faces should be unnecessary and because it could unbalance some particleboards it should be avoided.

### 4.4.4.5 Oriented strand board (OSB)

***Sawing***

OSB can be sawn with normal hand tools or with power saws. Tools designed for use with solid timber should be used.

***Spindle and router***

Simple profiles and routed forms can be produced readily with little risk of break out. The quality of finish increases with spindle speed and the number of cutters utilised.

***Drilling***

Drill speed and angle of the drill point should be the same as used for natural wood.

***Sanding***

The manufacture of the panel is such that some looseness of surface strands may occur. Where a smooth surface is required, a sanded panel should be specified or a light sanding given using hand or powered sanders. Excessive sanding of the faces should be unnecessary and, because it could unbalance some OSB panels, it should be avoided.

For general information regarding tip patterns, angles, feed speeds and cutting speeds, contact the tool manufacturer.

### 4.4.4.6 Cement-bonded particleboard (CBPB)

***Sawing***

Sawing can be done with a cross cut handsaw or a jigsaw with a coarse blade but is preferably done with a power saw fitted with TCT blades.

***Routing***

Rebates and grooves should be cut with a heavy duty router (not less than 1200 watt input). Bits should be TCT or high speed steel tipped.

***Drilling***

Use a normal hand drill or a high speed power drill (not the percussion type). The drill bits should have high speed steel tips. When drilling, a support should be used to ensure a clean hole.

***Sanding***

Orbital or belt sanders are best although small areas can be sanded by hand. Disc sanders should only be used by skilled operatives as they score the surface easily. Panels can also be worked with mechanical planers to produce featured edge details suitable for joints.

#### 4.4.4.7 Plywood

***Sawing***

The blade of a circular saw should enter the panel on the good face. This usually means that the panel is face down with a handheld saw and face up on a bench saw. TCT blades are recommended as the adhesives commonly used in plywood can lead to heavy wear. The panel should be supported as close as possible to the blade and best results will be achieved with:

- a fast material feed speed
- counter sawing (panel fed in opposite direction to the saw rotation)
- a minimum protrusion of the saw above the panel surface.

To minimise the risk of splintering the corners of the panel it is best if the cuts at right angles to the face grain are made first and those parallel to the face grain are made afterwards.

When using a band saw, the best results are achieved with the maximum saw speed and a slow feed speed.

Cutting speeds that have been found to be satisfactory are given in *Table 4.6*.

**Table 4.6: Cutting speeds found to be suitable for plywood[2]**

| | Cutter speed | Feed rate |
|---|---|---|
| **Circular saw** | 3000–6000m/min | 31 m/min |
| **Band saw** | 3000 m/min | 1–7 m/min |

***Routing***

TCT cutters are recommended in order to prolong tool life. A high cutter speed and slow material feed speed usually produces best results.

***Drilling***

To achieve a clean finish, drilling should start from the good face of the panel. Breaking out on the back of the panel can be avoided by drilling into a backing block.

***Sanding***

If a smooth surface is required, this can be achieved, depending on the veneer species and quality, by sanding parallel to the face grain with fine grade sandpaper.

### 4.4.5 Pre-finished and faced panels

For pre-decorated panels it is normal to cut down onto the decorated face. Chipping of the decorated surface can be eliminated by:

- using a saw with 10 or preferably more teeth per inch
- keeping a low angle of cut
- working to a knifed or scored line, the cut being made on the waste side of the line or placing masking tape on the decorated face over the intended line of cut. This makes marking easier (pencil lines can be readily drawn on the tape) as well as reducing chipping.

Face bevel and top bevel angles of saw blades may need adjusting for veneered or other faced panels.

When drilling through melamine faced panels the drill point angle should be between 80° and 90°.

It is recommended that plastic laminate veneered panels are reduced to finished component size by sawing and that spindling and routing cutters are only used on edges when the shape of the panel precludes sawing.

If it is necessary to rough cut oversize, careless cutting can cause hairline cracks in the surface which can lead to chipping on subsequent operations.

### 4.4.6 Health and safety

Cutting and machining of wood-based panels presents no more risk than that of any other material, provided that health and safety guidelines are followed. Further information on health and safety can be found in PanelGuide *Section 6*.

## 4.5 Fixing and installation

### 4.5.1 General

The method of fixing and installation can be critical to the satisfactory performance of wood-based panels in service. Panels can be fixed with nails, screws, staples, bolts, and other proprietary connectors or adhesives (sometimes in combination with fixings). It is important to consult manufacturer's literature in this respect and ensure that the fixing method is adequate for the end use.

Under the Construction Products Regulation[3], all dowel type fasteners (nails, staples, screws, dowels and bolts with nuts) that are manufactured from steel, and which are used in load-bearing timber structures, are required to comply with *BS EN 14592 Timber structures. Dowel type fasteners. Requirements*[4] and carry the CE mark, normally on the packaging. This will require the fastener manufacturer to declare a number of strength properties, one of which is 'characteristic head pull though'. This records the load required to pull the fastener through a wood-based substrate from the point side. OSB is often used as the testing substrate in this case.

### 4.5.2 Conditioning

Wood-based panels expand on taking up moisture and shrink on losing moisture, be it from or to the surrounding air or from other parts of a structure with which they are in contact. It is important that, prior to fixing, the panels are at a moisture content as close as possible to that which they will attain in service. See *Section 4.2.4* for further information.

### 4.5.3 Movement gaps

When full panels are fixed in place, it may be necessary to leave gaps at their perimeters to allow for expansion. Two alternative strategies are possible:

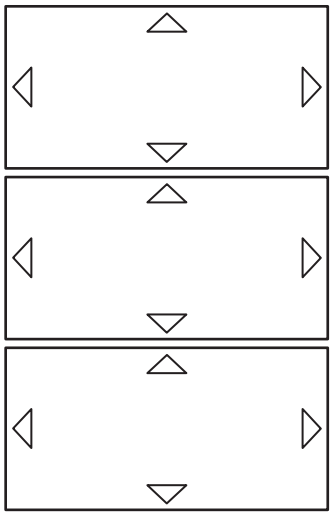


**Figure 4.7a: Rigidly fixed panels with movement gaps at joints**

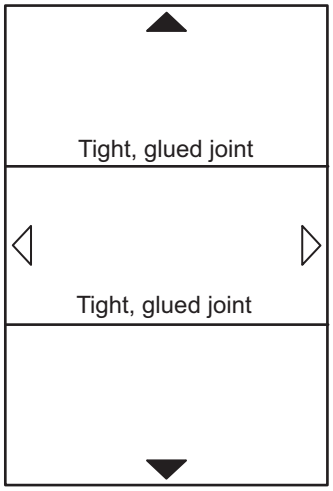



**Figure 4.7b: Panels fixed as a composite unit with a movement gap at the perimeter**

- If the panels are to be rigidly fixed (eg by adhesive or screws at relatively close centres) to their substrate, a 3mm gap should be left at all edges of each panel (except softboard where no gap is normally required), see *Figure 4.7a*.
- If adjacent panels are rigidly joined together (eg by a glued tongued and grooved joint), and are fixed to the substrate by a method which allows a small amount of movement, such as nails or by the use of angled battens in a wall lining, it is possible to treat a number of panels as a composite unit and transfer the total movement gap to the perimeter of the unit, see *Figure 4.7b*. As a general guide a perimeter gap should be equal to 2mm per metre run and a minimum of 10mm; however for different applications, for example flooring or wall sheathing, the relevant section of PanelGuide should be consulted for more detailed information regarding the size and positioning of expansion gaps.

The above guidance is based on normal practice and should prove adequate; if a manufacturer produces more specific guidance for their products then this should be followed.

## 4.5.4 Edge distances

Panels should generally be fixed so that all edges are fully supported by a tongued and grooved joint, a joist or by a noggin. Fixing centres for nails and other mechanical fasteners vary for each panel type and its intended use. In general, fixing centres are closer around panel edges than on intermediate framing.

For all panels, nails and other mechanical fasteners should not be inserted close to the panel edges as this can lead to 'tear out'. Typical minimum edge distances are shown in *Table 4.7*, but the panel manufacturer's recommendations should be followed if these are available. The minimum dimensions shown are affected by the type of fixing and panel thickness, and smaller dimensions can be achieved in some circumstances. If the dimension shown in the table is less than three times the diameter of the fixing, then the latter figure should be used.

It is necessary to adopt a fixing method which does not cause bow or distortion of the panel, especially with thin panels. It is usually advisable to start from one edge of the panel and work across, ensuring that the panel is kept flat.

## 4.5.5 Length of fixings

Fixings should have a minimum length of 50mm or 2.5 times the panel thickness, whichever is the greater. Where engineering design requires a certain fastener type and spacing, this must be adhered to.

Nails should generally be punched home by 2 to 3mm and screws countersunk where fixings are visible or are

**Table 4.7: Minimum edge distances for fixings in panel face**

| Panel type | Minimum edge distance (mm) | Minimum distance from corners (mm) |
|---|---|---|
| **Softboard** | 8 | |
| **Mediumboard** | 6 | |
| **Hardboard** | 6 | |
| **MDF** | 12 | 25 |
| **Particleboard** | 8 | 25 |
| **Flaxboard** | 8 | 25 |
| **OSB** | 8 | 25 |
| **Cement-bonded particleboard (CBPB)** | 15mm for panels <16mm thick<br>20mm for panels <22mm thick | 40 |
| **Plywood** | 9 | 15 |

likely to cause inconvenience or danger if left protruding from the surface, for example in flooring or furniture.

## 4.5.6 Nails

There are many types of nail available, some are described below and are shown in *Figure 4.8*.

- **Panel pins** – are suitable for many applications where a concealed fixing is desirable but where there is no likelihood of a 'pull-off' force. They are often used in conjunction with adhesives to give temporary support while the adhesive cures.
- **Round lost head nails** – for flooring and carcassing work these are simply driven flush with the panel surface, but for concealment they should be lightly punched into the panel. Lost head nails are preferred for secret nailing through the tongue of tongued and grooved panels.
- **Headed nails** – headed types of nails are used for general purpose nailing where appearance is not the main factor and particularly where the panel needs to be held firmly against its substrate, in structural uses, or where there is a likelihood of a 'pull off' force being applied.
  The nail should be driven so that the head is tight against the panel since it is the head which provides the grip. If the panel is to be decorated the head may be driven into the panel slightly and then filled. Types include:
  - Round plain head nails: often called round wire nails, are usually made from bright steel, not treated against corrosion.
  - Lath nails: which have a larger head than round head nails and are usually galvanised.

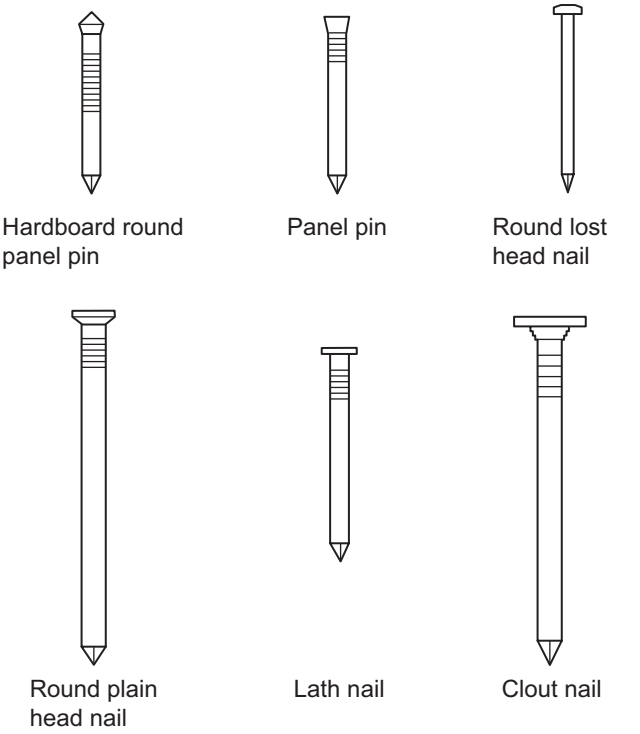



**Figure 4.8: Examples of nail types**

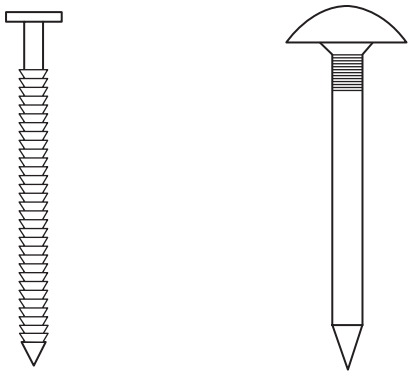


**Figure 4.9: Examples of special nails**

  - Clout nails: are generally thicker than round plain head nails, have broader heads and are usually galvanised. Because of the head size they are the preferred method of fixing softboard, particularly for structural applications (eg sheathing to timber frame construction).
- **Special nails** – these include nails with improved resistance to withdrawal, improved appearance and for power assisted insertion. Types include:
  - Improved nails including annular ringed shank and square twisted nails: ribs on the shank result in a fixing with improved resistance to withdrawal. They are also preferable in instances where vibration may loosen conventional nails, (eg in flooring) even though there is no axial load on the nail. Plain and non-corroding types are available.
  - Domed head nails: the shank may be plain or annular, though usually the latter. The head may be made from the same material as the shank (ie bright or stainless steel) or may be in an impact resistant plastic cap. These nails are used mainly with pre-decorated panels. For claddings the head is driven tight to the panel but not overdriven, so that any slight thickness swelling of the panel does not cause the nail head to rupture the panel surface.
  - Strip nails: many types of nail are now available in strips for use with electric or pneumatic nail machines.

## 4.5.7 Screws

Screws provide a higher strength fixing than nails or staples but can be more expensive and time consuming to install. Because of these factors it is customary to use, for a given installation, fewer screws per unit area. This may call for the use of a thicker panel than would be required with high density nailing or gluing. The use of screws is not therefore recommended in large areas of panel which have a thickness less than 6mm. The main types of screws used with wood-based panels are conventional woodscrews, parallel shank woodscrews and double threaded parallel shank woodscrews. For fixings into panels the parallel shank type screw is generally preferable. When screws are used for panel to panel fixings, a slightly oversize hole should be drilled in the uppermost panel.

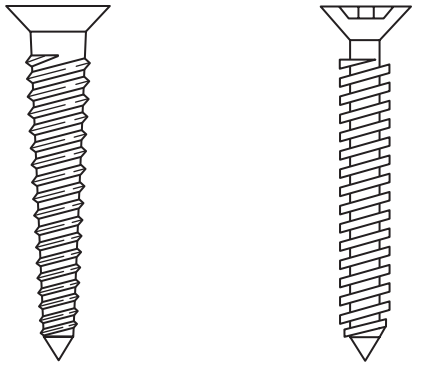



**Figure 4.10: Screw types**

## 4.5.8 Staples

Staples are usually simple thin wire U-shapes with two points. Variations include: staples made from thicker flat or oval wire, wide crowns up to 28mm, divergent shank and clinched staples (both of which improve pull out resistance) made from mild steel with protective coatings from stainless steel.

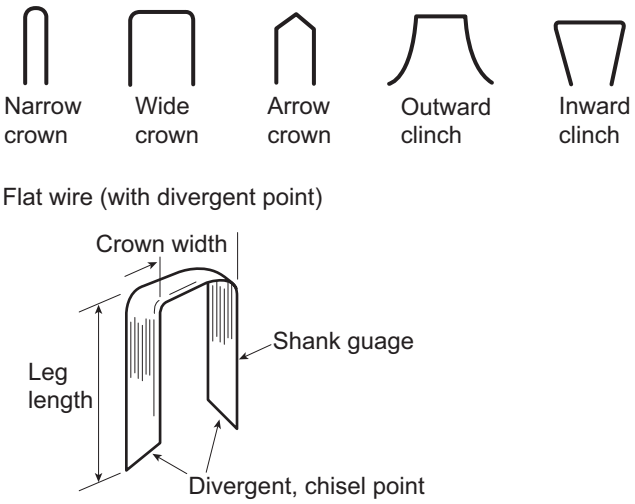



**Figure 4.11 Staple types**

## 4.5.9 Special fasteners

There is a wide range of proprietary fasteners designed for particular applications, for example to spread the load over a wider area, for fixing through the face of panels where there is no support behind for a conventional screw fixing and for demountable or knockdown fittings. Some types of fastener which provide a high degree of resistance to withdrawal require a fitting hole larger than the screw or shank diameter and thus lateral location will be less positive than with fasteners which expand or deform.

## 4.5.10 Adhesives

Adhesives are used for fixing panels in position, joining panels together, and fixing surface laminates, veneers or edge lippings.

Adhesives can be structural or non-structural, used alone or with mechanical fasteners. In the latter case, the mechanical fastener holds panels in position and provides bonding pressure while the adhesive cures.

Traditional animal-based glues have been superseded by the wide range of synthetic adhesives formulated for specific materials, application techniques and end-use requirements. The following notes provide general guidance on choice of adhesives for use with wood-based panels; for specific applications it is recommended that manufacturers and suppliers are consulted.

Adhesives groups include:

- Hot bitumen and bitumen based adhesives. These are used primarily for fixing impregnated softboard in roofing applications.
- Thermoplastics including hot melt adhesives and PVAC (polyvinyl acetate) emulsions. PVAC emulsions are a good general purpose adhesive for internal use in generally dry conditions. Modified PVACs with improved moisture resistance are also available. PVAC has no initial bond so materials must be held in position by clamping or pinning until the adhesive sets.
- Thermosetting resins, primarily formaldehyde-based synthetic resins of urea (UF), melamine (MF), melamine urea (MUF), phenol (PF), resorcinol (RF), resorcinol phenol (RPF) and epoxy resins.
  Formaldehyde-based resins are suitable for use as structural load-bearing adhesives. They can be cured by the application of heat but are available for setting at room temperature. They are available as gap-filling and close contact adhesives.
  UF and MF resins have limited weather resistance and should only be used in internal or protected situations; PF and RF resins have good moisture resistance and give good durability when exposed to the weather.
- Elastomers – solutions in organic solvents. Types include contacts and adhesives for use in thick glue lines of which SBR (styrene butadiene resin) emulsions are an example. Contact adhesives have good initial grab and do not require clamping or pinning before full bond is developed.
- Polyurethane adhesives (moisture curing adhesives) provide a water-resistant bond and some glues can have gap-filling capabilities depending on the formulation of the adhesive.

There are also numerous proprietary products available, often for specific purposes.

In selecting an adhesive some performance aspects to consider are:

- Strength.
- Moisture resistance and long-term durability.
- Ease of use: some adhesives require mixing at the point of use; some require the application of pressure until the bond has developed fully; some applications require the ability to reposition the panel; some have

more arduous health and safety requirements (always obtain a material safety data sheet for the specific adhesive used and follow the guidance therein).
- Curing times.
- Compatibility with panel binders and coatings or impregnation.
- For thin panels, adhesives with fillers may not spread sufficiently when the panel is pressed into position and the spreading pattern of the adhesive may 'grin' through the panel.

## 4.5.11 Fixing requirements for different products

The above guidance is generally applicable to most wood-based panels, but some particular types have special requirements. The following sections outline some of these, but reference should also be made to any specific guidance provided by the panel/fixing manufacturer.

### 4.5.11.1 Fixing softboards

Softboards can be fixed with nails, staples and screws; the type used will depend upon the end use. Nails with large heads are recommended and screws should be fitted with cups. Softboard can be bonded with most types of woodworking adhesive and with bitumen adhesives for applications such as roofing. Due to their low density, softboards will not hold fixings satisfactorily when these are loaded. An appropriate type of cavity fixing which will spread the load should be considered.

### 4.5.11.2 Fixing hardboards and mediumboards

Hardboards can be fixed with panel pins, nails, staples and screws; the type used will depend upon the end use. Screws through thinner hardboards should have cups if 'pull through' is a possibility.

Hardboard and mediumboard can be bonded with most types of woodworking adhesives. Fixings into hardboard and mediumboard should generally use cavity fittings.

### 4.5.11.3 Fixing MDF

MDF can be fixed with nails, staples and screws. The type of nail used will depend upon the panel thickness and end use. Pilot holes should be drilled for screw fixings. The hole diameter should be larger than those recommended for solid wood and particleboard; typically the holes should be 85 to 90% of the screw core diameter. Fixings into the panel face should not be nearer than 12mm from edges nor 25mm from corners. Screws into the panel edge should be not less than 70mm from corners (see *Figure 4.12*).

MDF can be bonded with all types of woodworking adhesive. The type selected will depend on end use.

MDF provides good holding power for screw fixings into panel faces and edges. Parallel core screws have greater holding power than conventional woodscrews and are recommended for this purpose. A high overall diameter to core diameter ratio is desirable. Nails and staples can

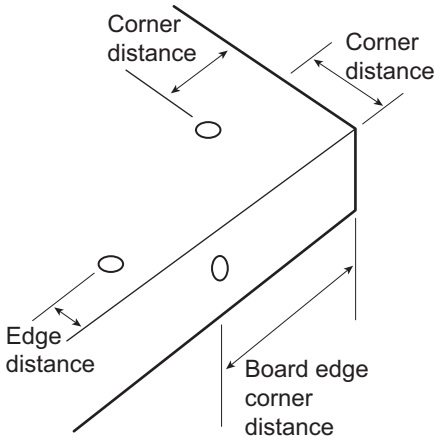



**Figure 4.12: Fixing positions**

be used for lightly loaded fixings or to hold glued joints while adhesive sets. Edge and corner distances should be as shown above.

Dowel joints can be satisfactorily used with MDF. Multi-grooved dowels are recommended. Dowels and holes should have an 'interference' fit, ie of such size that the dowel can be pushed home by hand but, even without adhesive, not sufficiently loose that it can fall out. Some tolerance must be allowed on the dowel diameter, typically up to 0.2mm oversize. It is desirable to allow for this when drilling the holes. Recommended dowel sizes for different thicknesses of panel are given in *Table 4.8*.

**Table 4.8: Dowel diameters (mm) for joints in MDF**

| Panel thickness (mm) | Dowel diameter (mm) |
|---|---|
| 15 or less | 6 |
| 16 to 24 | 6 or 8 |
| 25 or more | 10 |

### 4.5.11.4 Fixing particleboard and flaxboard

Particleboard can be fixed with nails, staples, screws and glue (proprietary systems only). The type of nail used will depend upon the panel thickness and end use. Pilot holes should be drilled for screw fixings. Fixings into the panel face should not be nearer than 8mm from edges nor 25mm from corners.

Particleboard can be bonded with all types of woodworking adhesive. The type selected will depend on end use. Some manufacturers offer proprietary fixing systems (generally for flooring) using glues or a combination of glue and fixings.

Particleboard provides good holding power for screw fixings into panel faces. Parallel core screws are preferable as they have greater holding power than conventional wood screws. Nails and staples can be used for lightly loaded fixings or to hold glued joints while the adhesive sets.

Dowel fixings can be used with particleboard, although they are generally used as a location device in conjunc-

tion with appropriate adhesives. They should normally be inserted at 150mm to 200mm centres and penetrate no more than two thirds of the panel's thickness.

#### 4.5.11.5 Fixing cement-bonded particleboard (CBPB)

Panels can be fixed with nails or screws, but because of their high alkalinity, these should be in stainless steel or should be galvanised. Panels up to 12mm thick can be nailed through the face by hand without pre-drilling, thicker panels should be predrilled. Pre-drilling is not required for power nailing.

Pre-drilling is required for screw fixings except when power screwing is used. Where the panel is on the head-side (eg panel on floor joists where floor joist is point-side) of the joints, holes should be slightly oversize to the screw diameter. Edge distance for fixings should not be less than 15mm for panels up to 16mm thickness, not less than 20mm for panels over 16mm and up to 22mm thickness.

CBPB of the appropriate thickness is a suitable substrate for screw fixings.

Because of the relatively high alkalinity (pH) value of CBPB, PVAC and resorcinol adhesives are usually recommended. The panel manufacturer's advice should be sought.

#### 4.5.11.6 Fixing OSB

OSB can be fixed with nails, staples and screws. The type of nail used will depend upon the panel thickness and end use. Pilot holes should be drilled for screw fixings. Fixings into the panel face should not be nearer than 8mm from edges nor 25mm from corners. Edge and corner distances should be as shown in *Figure 4.12*.

OSB can be bonded with all types of woodworking adhesive. The type selected will depend on end use.

OSB provides good holding power for screw fixings into panel faces. Parallel core screws have greater holding power than conventional woodscrews. Nails and staples can be used for lightly loaded fixings or to hold glued joints while adhesive sets.

#### 4.5.11.7 Fixing plywood

Plywood can be fixed by nails, screws, staples or by gluing, depending upon the application and requirements. There are also proprietary fixing systems available. Glued joints provide a higher degree of stiffness than most mechanically fastened joints but it is important that the glue type is appropriate to the end use.

The cross-laminated structure of plywood means that fixings can be inserted quite close to the edges of panels.

# 4.6 Joints and joint details

## 4.6.1 Conditioning

Timber and wood-based products expand on taking up moisture from the air and shrink on losing moisture. It is important that panels are installed at a moisture content close to that which they will achieve in service. Such panels must then be given sufficient protection throughout the construction process to maintain this in-service moisture content. *Section 4.2.4* provides further guidance on this topic.

## 4.6.2 Panel to panel joints

All joints should allow for the small dimensional changes which can occur in the panels, substrate or fixing as a result of changes in temperature and relative humidity. This will be more apparent in external cladding and sheathing than in internal linings where the initial movement to equilibrium moisture content may be the only dimensional change. In certain circumstances it is possible to produce a flush joint (or joints) between several panels without allowing for movement, providing an appropriate allowance is made around the composite panel.

- Joints on internal wall and ceiling linings need to be visually acceptable.
- Joints in external sheathing need to be watertight and airtight as well as providing adequate rigidity for the structure.
- Joints in external cladding need to be visually acceptable and protect the structure beneath from exposure to wind and rain but avoid retention of moisture within the joint, the adjacent panels or any cavity behind.
- Horizontal joints need to be particularly effective, especially at the head of walls or where a façade is interrupted by windows and other openings.
- Joints on surfaces which will be painted need to allow for maintenance of the surface coating within any recesses formed.

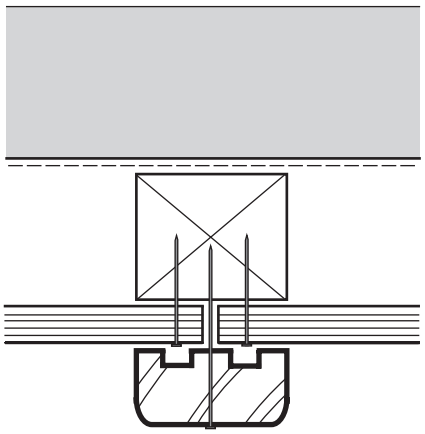


**Figure 4.13: External cladding joint sealed with non-setting sealant, backed by foam breaker strip, and with timber cover strip to the joint**

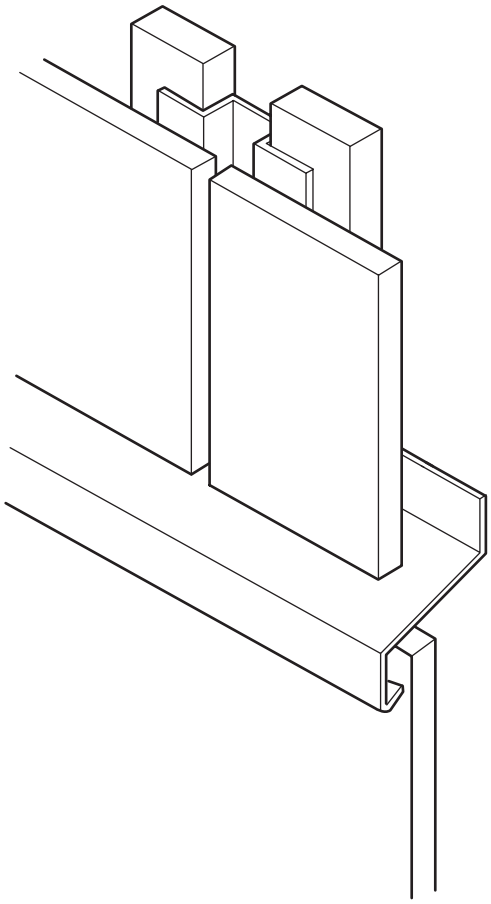


**Figure 4.14: Vertical and horizontal external cladding joints using pressed metal 'top hat' and drained bottom bead profiles to allow drained and ventilated cladding**

## 4.6.3 Lining and cladding joint types

As changes in relative humidity result in slight movement in all wood-based panels, it is preferable to design joints in linings and claddings to accommodate this.

Featured joints include: tongued and grooved joints, lapped joints, open or gapped joints, covered with plastic, metal or timber cover strips, or filled with matching or contrasting sealants.

It is important to consider internal and external angles and the relationship with horizontal joints to be used.

*Figure 4.13* and *Figure 4.14* show two examples of external cladding joints, one of which is a sealed and bedded joint and the other is a drained and ventilated arrangement. In *Figure 4.13*, the foam breaker strip serves to prevent the sealant adhering to the batten.

*Figure 4.15* illustrates a number of alternative internal lining joints where more variation is possible due to the less critical environment to which they are exposed. If internal lining joints are subject to moisture from washing down or similar cleaning, it is suggested that a sealed and bedded joint should always be used.

## 4.6.4 Carcase joints

Glued joints and proprietary 'knock down' fittings can be used with MDF, particleboard and OSB in the manufacture of furniture and fittings. Joints can be made as unobtrusive as possible, using flush face or edge joints

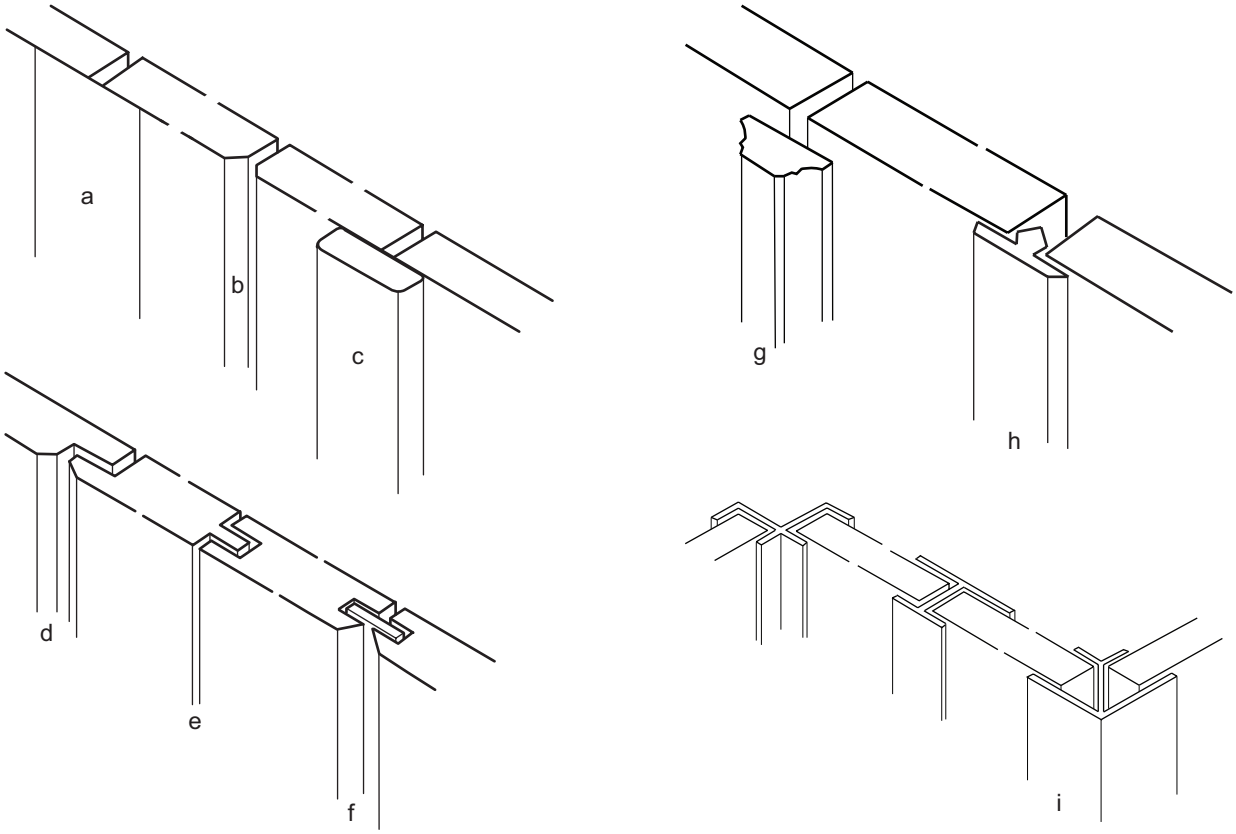



**Figure 4.15: Typical internal lining joints**
a) butt joint with scrim for plaster skim finish, b) butted V joint for face fixing, c) butt joint with cover strip, d) rebated V joint for face fixing, e) secret fixed tongued and grooved joint, f) V joint with loose tongue, g) butt joint with moulded timber or MDF cover trim, h) butt joint with push fit metal or plastic trim, i) proprietary aluminium or plastic joint system,

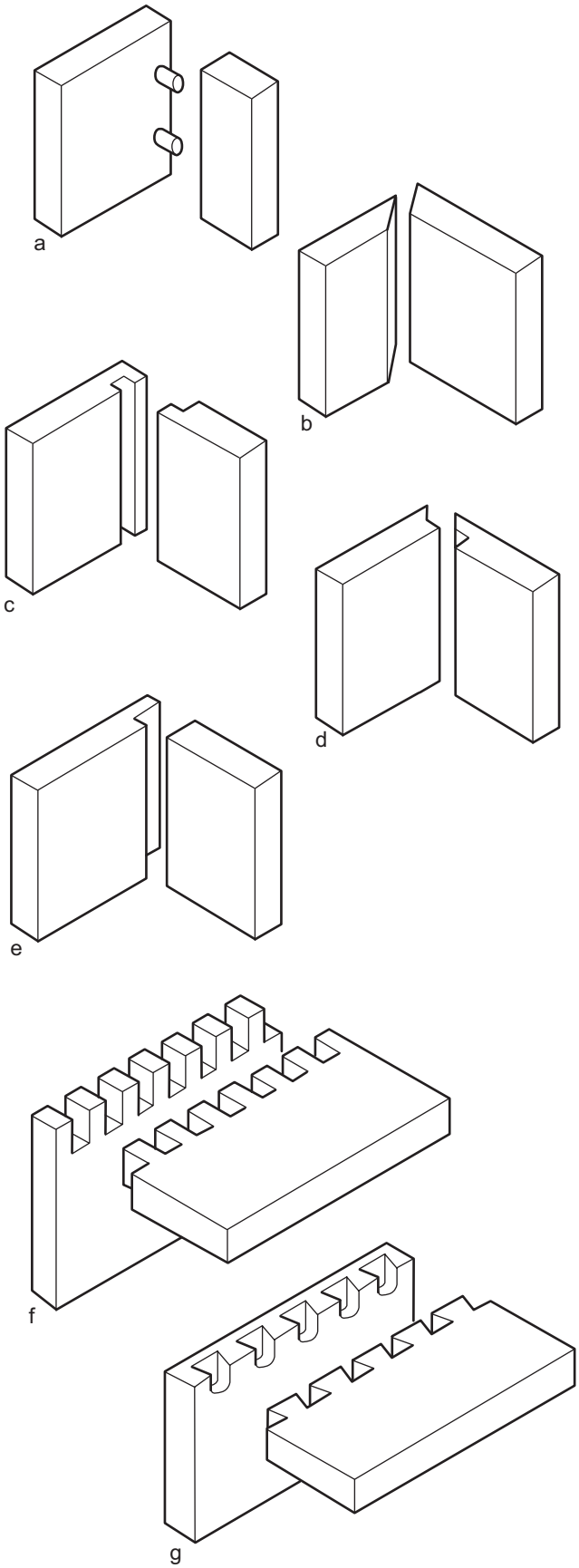



**Figure 4.16: Typical joints used in furniture construction**
a) dowels
b) mitre
c) tongue and groove
d) lapped mitre
e) rebate
f) comb unit
g) stopped machine dovetail

where only the glue/joint line is visible, or featured by using the component parts to emphasise the joint or by profiling or rebating adjacent to the joint. Examples of joints are shown in *Figure 4.16*. When knock down fittings are used, those which depend upon expansion of a component into the panel edge should be avoided as they can cause delamination of the panel.

Many of the joints used in traditional woodwork can also be used with particleboard and MDF including comb joints, dovetails and tenons.

Provided that edges have been cleanly cut, a plain butt or mitred glued joint provides adequate strength for many situations where the joint remains dry. However, some means of ensuring accurate locations of the components to be joined is often useful in assembly; for example, a rebate, a loose tongue, a biscuit insert or dowels may be incorporated in a straight butt or a mitred joint. Such devices generally assist in locating the components and add to the strength of a joint. Joints may also be held together while the adhesive sets using nails or pins.

Mitre and butt joints are generally not suitable in situations of high or variable moisture content, where movement can lead to failure of the joint.

The width of grooves machined into the edge of panels should not normally exceed one third of the panel thickness and grooves in the depth of the panel should not generally exceed half the panel thickness.

Tongues, biscuits and dowels should fit easily into holes or grooves in the edge of panels, as tight fitting inserts can result in delamination of the panels. Dowels should preferably be of the multi-grooved type and a hole diameter 0.2mm larger than the dowel is generally recommended. The depth of the hole or grooves should also be slightly more than the penetration depth of the insert. Normal woodworking adhesives can be used.

Screw fixings can be made into the faces of particleboard and OSB and the faces and edges of MDF and cement-bonded particleboard. Parallel core screws give better holding performance than traditional woodscrews. Screw fixings should generally have pilot holes. See *Section 4.5* for further information.

## 4.6.5 Edging and lipping

Particleboard and MDF panels can be finished with decorative edging or lipping to hide or protect the core material, or to match or complement the surface finish. These can be glued or mechanically fixed. Some examples are shown in *Figure 4.17*.

Edge finishes include:

- Edge veneers – provided that the edge has been cleanly cut, further treatment of the edge surface is usually unnecessary. Veneers can be applied by hand or machine.

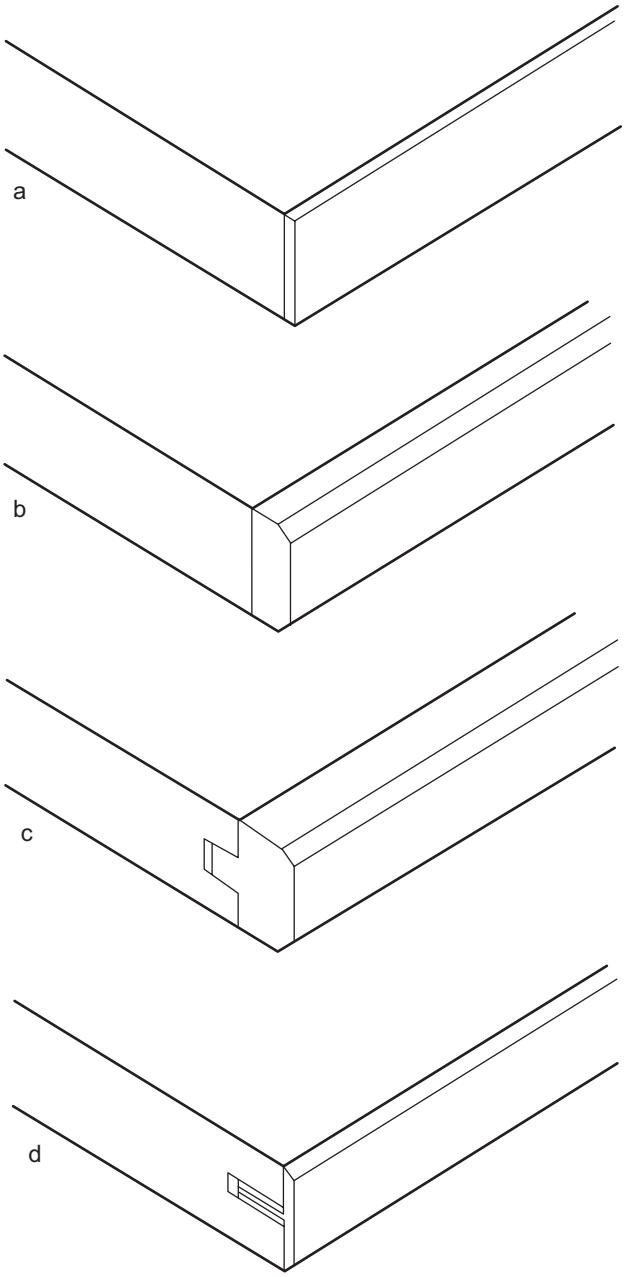



**Figure 4.17: Typical edging details**
a) edge veneer
b) solid lipping; butt joint
c) solid lipping with tongue
d) toothed metal or plastic lipping

- Solid lipping – these can be glued on with a butt joint, or have a tongue to facilitate location. Lipping is normally applied after panel surfaces are veneered or laminated. Lipping can be applied before veneering or laminating if required, the adhesive should be allowed to harden completely before veneering and sanded down to avoid 'show through' at the glue line.
- Metal or plastic trims – commonly used with laminate finished panels – these can either have a toothed tongue on the back which is pressed into a thin groove in the panel edge, or be face pinned or screwed.
- Profiled edge – the edges of some wood-based panels, especially MDF, can be accurately profiled to a very high standard and can be sealed and painted or veneered to match the face surfaces.

# 4.7 Decoration and finishing

## 4.7.1 General

All wood-based panels (except bitumen impregnated fibreboards) provide suitable substrates for paints, stains, varnishes and textured coatings.

Lining materials such as wallpaper, hessian and other fabrics can also be applied providing an appropriate adhesive is used, but they are not generally used on MDF or OSB.

Hardboards, mediumboards, MDF, particleboard, flaxboard, OSB and plywood can be veneered and laminated with high and low pressure laminates, paper and PVC foils, although not all of these can be applied to all types of fibreboard and particleboard. The most common combinations are shown in *Table 4.9* below.

Some types of panel are available pre-decorated or with applied finishes.

## 4.7.2 Conditioning

Timber and wood-based products change dimensions (length, width and thickness) in response to atmospheric moisture gain and loss – they expand on taking up moisture from the air and shrink on losing moisture. It is

**Table 4.9: Suitability of finishes**

| | Water-based paint | Oil-based paint | Varnish | Stain | Wallpaper fabrics | Plastic laminates | Wood veneer | Foils |
|---|---|---|---|---|---|---|---|---|
| **Softboard** | ✓ | ✓ | | | ✓ | | | |
| **Mediumboard** | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ |
| **Hardboard** | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ |
| **MDF** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Particleboard** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Flaxboard** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **OSB** | ✓ | ✓ | ✓ | ✓ | | | ✓ | |
| **CBPB** | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ |
| **Plywood** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

Key : ✓ = suitable

**Table 4.10: Suitability of adhesives for applying coatings**

| Adhesive type | Wood veneer | Plastic laminate veneer | Paper foil laminate | PVC foil laminate | Wallpaper, hessian etc |
|---|---|---|---|---|---|
| **PVAC** | ✓ | ✓ | ✓ | | |
| **UF** | ✓ | ✓ | ✓ | | |
| **Neoprene** | | ✓ | | | |
| **Copolymer EVA** | | | ✓ | ✓ | |
| **Epoxy** | | | | ✓ | |
| **Polyurethane** | | | | ✓ | |
| **PVAC-based wallpaper adhesive** | | | | | ✓ |

Key : ✓ = suitable
Note: The alkalinity of cement-bonded particleboard precludes the use of some types of adhesive. The manufacturer's advice should be sought.

important that panels are installed and/or finished at a moisture content close to that which they will achieve in service (see *Section 4.2.4* for further information).

## 4.7.3 Adhesives

When applying veneers, laminates, paper and PVC foils to fibreboards and particleboards it is essential to select adhesives appropriate to the materials, the scale of the operation and the facilities available to carry out the work. Materials suitable for large-scale factory application are not necessarily suitable for use on site. *Table 4.10* includes general guidance on suitable adhesives, and manufacturer's advice should be sought for further information.

The use of water-based adhesives for applying wallpaper and similar finishes may result in panel distortion, fibre swelling and/or edge swelling unless panels and joints are sealed first.

## 4.7.4 Painting and sealing

Virtually all paints have a tendency to draw away from a sharp edge or corner. It is therefore recommended that all corners and edges be rounded to a radius of at least 3mm, by machining or light sanding, to enhance paint retention. This is particularly important with panels exposed to exterior conditions.

Where appropriate types of wood-based panels are used, for example as external cladding, infill panels or soffits, it is important that the finish applied is suitable for external use and provides the required protection to the panel. Paints and stains formulated for external use on natural timber can be used on wood-based panels. These should be applied in accordance with the manufacturer's instructions.

The edges of most panel types are more porous than the panel surfaces. As a result, absorption at the edges is greater than on the face and if panels are subject to a changing humid or exterior climate, care must be taken to ensure that the edges are adequately sealed.

For exterior conditions, it is particularly important that all surfaces are effectively sealed before the application of the primer and top coats. Refer to the panel manufacturer or sealant manufacturer's literature for recommendations.

Dry film thickness (build) is critical to performance of a paint coating. Simply applying enough paint to hide the colour of the substrate is not adequate and manufacturer's guidelines should be followed.

Some flame retardant treatments are very alkaline and treated panels may need a special primer before painting. The same is true for cement-bonded particleboard.

Once properly sealed and primed, most wood-based panel products can be top coated with an exterior coating suitable for wood products. The top coat should be applied to all surfaces and edges in accordance with the paint manufacturer's recommendations. Several thin coats of paint normally gives a better performance than a single thick coat, but each coat must be allowed to dry thoroughly before the application of the next.

Under exterior conditions, the following points are particularly important:

- All uncoated edges or surfaces of prefabricated components must be fully coated prior to assembly or exposure to weathering.
- To aid with edge sealing, all edges must be rounded to a minimum 3mm radius.
- Solvent-based sealers are particularly recommended for initial coating of the panel. Water-based sealants may lead to raising of fibres, requiring re-sanding after drying, before subsequent coats.
- Some types of transparent stains are not recommended as they allow degradation by ultra-violet light. Exterior coatings should contain a suitable UV inhibitor.
- The design of components should eliminate potential areas of water collection.
- Both sides of the panel should be evenly coated. Otherwise, differential moisture changes on the two sides of the panel may lead to distortion.

- Mitre joints are not recommended due to the difficulty in coating sharp edges. Edge to face joints offer a similar aesthetic appearance with improved coating and edge protection.
- A coating maintenance programme in accordance with the coating manufacturer's recommendations should be adopted in order to ensure maximum life from the panels.

## 4.7.5 Ceramic tiling

Ceramic tiling be can successfully applied to wood-based panels in all manner of different situations, but care has to be taken in order to achieve adequate performance.

This is for two reasons:

- Ceramic tiling provides a rigid coating and requires a rigid substrate to prevent cracking of the tiling. This is especially true for floors, because of the movement under load.
- Wood-based panels are subject to changes in dimension as a result of changes in moisture content. This can lead to cracking of the tiling. Also different wood-based panel products will behave differently with respect to the amount of moisture movement they exhibit.

As ceramic tiles tend to be used in areas subject to regular or accidental wetting, such as kitchens and bathrooms, special care should be taken to avoid problems and all use situations should be approached with caution.

The guidance in *BS 5385-1 Wall and floor tiling. Design and installation of ceramic, natural stone and mosaic wall tiling in normal internal conditions. Code of practice*[5] and *BS 5385-3 Wall and floor tiling. Design and installation of internal and external ceramic tiling in normal conditions. Code of practice* [6] and publication *Tiling to timber sheets and board, timber substrates and alternative products*[7] should be consulted for further detailed information on various end-use situations from dry to prolonged contact with water.

## 4.7.6 Finishing softboard

### 4.7.6.1 Surface coatings

Softboard can be painted with conventional oil-based and water-based paints, applied by spray, brush or roller. Matt or satin finishes can be obtained. Panels should be brushed free of dust before decoration commences. No rubbing down of the surface should be required.

Natural and ivory faced panels should have a primer or sealer coat applied, a 50/50 mix of emulsion paint and water is suitable for this purpose. White primed softboards can be painted without using a sealer coat.

If further coating is applied, an alkali resisting primer is required and the panel or paint manufacturer's advice should be sought.

If panel edges will be visible after completion it may be necessary to fill these with a wood or cellulose filler prior to the application of finish.

Textured coatings can also be applied. Care is needed in detailing panel joints which should be either scrimmed and filled or featured by leaving small gaps between adjacent panels. Coating manufacturer's recommendations regarding priming of panels should be closely followed. After joint treatment, the paint is applied and textured (stippled, combed etc). The edges are normally finished by using a small brush to produce a plain margin.

### 4.7.6.2 Paper and fabric finishes

Softboard can be faced with materials such as textured paper, fabric or hessian. This is best done after the panels are fixed into place. When selecting a softboard for wallpapering, the types that have a fine pulp overlay are preferable as these usually have a smoother surface than natural softboard. When using wallpaper, care is necessary to avoid movement at panel joints causing splitting or rucking in the applied finish; a robust textured paper material is usually preferable. When bonding on paper or fabric finishes, the panel will require 'sizing' to prevent excessive absorption of adhesive and to make it easier to remove the lining material at a later date. ('Sizing' is a decorating term which means sealing the surface with a coating of adhesive that is allowed to dry before application of the wallpaper.)

## 4.7.7 Finishing mediumboard and hardboard

### 4.7.7.1 Surface coatings

Mediumboard and hardboard can be painted with conventional oil-based and water-based paints, applied by spray, brush or roller. Matt, satin or gloss finishes can be obtained. Little preparation of the surface should be required, dust and grease should be removed from the panel, if necessary using white spirit.

Panels should have a primer or sealer coat applied, this can be a proprietary hardboard sealer or a coat of emulsion paint. Some types of oil-tempered hardboard (which contain natural or added oils) require priming with an aluminium primer or multi-purpose primer.

If panel edges will be visible after completion, it may be necessary to seal these with hardboard sealer or with a wood or cellulose filler prior to the application of the finish.

Textured coatings can be applied but care is needed in detailing panel joints which should be either scrimmed and filled or featured by leaving small gaps between adjacent panels (see *Section 4.5.3* for further information). Coating manufacturer's recommendations regarding preparing and priming of panels should be closely followed. After joint treatment, the paint is applied and textured (stippled, combed etc). The edges

are normally finished using a small brush to give a plain margin.

#### 4.7.7.2 Paper and fabric finishes

Hardboard and mediumboard can be faced with materials such as fabric or hessian. This is best done after the panels are conditioned and fixed into place. When using wallpaper, care is necessary to avoid movement at panel joints causing splitting or rucking in the applied finish; robust textured papers and materials are usually preferable. When bonding on paper or fabric finishes, Type MBL mediumboard should be 'sized' before application. For all types of hardboard or mediumboard it is advisable to seal the panel surface first with an acrylic primer or hardboard sealer so that subsequent removal will be easier.

#### 4.7.7.3 Laminates, foils and veneers

Plastics, laminates, foils and veneers can be bonded to hardboard without pre-treatment. Care is necessary to ensure that all materials have similar moisture contents and balancing laminates or veneers will generally be required to avoid panel deformation.

### 4.7.8 Finishing MDF

#### 4.7.8.1 Opaque surface coatings

MDF can be finished with a wide range of opaque coatings. The surfaces to be finished should be free of dust or sanding marks. The faces of MDF are pre-sanded with 120 grit abrasive which provides a smooth surface suitable for most opaque finishes without further sanding. The use of 200 or 320 grit papers may be advisable when using high gloss finishes or when a minimum coating thickness is required.

Opaque paints are the easiest finishes to apply as their high solids content allows a high build. A base coat and a finish coat are usually all that is required. Pigmented systems can provide single colour finishes; more specialised techniques and lacquers can enable metallic marbled and other finishes to be obtained. The selection of the finishing system will be dependent upon the scale of production, application equipment, drying facilities and the expected performance of the finish in use.

Good results can be obtained using conventional oil-based or water-based paints. Better results can be achieved in a shorter time using lacquers based on nitrocellulose, acid catalysed resins, polyurethane or polyester resins applied by hand spray.

High gloss finishes can be obtained using a high build coating based on polyester resins, possibly with a clear lacquer top coat to protect the surface and enhance the gloss effect.

Panel edges may require sealing with shellac, polyurethane, diluted PVAC, or specially formulated high solid sealers to compensate for their greater absorption.

Flame retardant panels are available to meet Euroclass B or C requirements. If further coating is applied to these, the panel or paint manufacturer's advice should be sought as the coating may affect the reaction to fire properties.

#### 4.7.8.2 Satin or lacquer finishes

Clear lacquers and varnishes can be used on MDF. Application and preparation is similar to that for pigmented finishes. When coloured translucent finishes are required, decorative stain finishes can be used. Solvent-borne stains will wet the surface effectively and ensure an even colour; water-borne stains can also be used but the waxes sometimes added to the hardboard and MDF to reduce water absorption may result in uneven absorption of stain and consequent colour variation. Stained surfaces can be protected by one or two coats of clear lacquer with a light denibbing between coats using 320 grit paper.

As the edges of MDF are more absorbent than surfaces, stain finishes applied to edges may result in darker colours compared to surfaces. Edges can be sealed before staining, using shellac, polyurethane, diluted PVAC or specially formulated high solid sealers to reduce this effect.

#### 4.7.8.3 Laminates, foils and veneers

MDF can be surfaced with plastic laminates, paper and PVC foils and veneers. Wood veneers and foils can also be applied to shallow profile surfaces. Balancing laminates or veneers will generally be required to avoid panel deformation. The inherent smooth surface of MDF also allows heat transfer foils to be applied to both the face and profiled edges of the panel.

### 4.7.9 Finishing particleboards and flaxboards

#### 4.7.9.1 Opaque surface coatings

Particleboard can be painted with conventional oil-based and water-based paints applied by spray, brush or roller. Matt, satin or gloss finishes can be obtained; textured coatings may also be applied. In order to achieve a high quality paint finish, panels may require filling prior to painting since, although the surface appears to be smooth, it can contain small holes and interstices which become noticeable when paint is applied. Before applying a filler, the panel should first be primed. A normal plaster-based filler is then applied and rubbed down to give the desired surface.

Panels with especially fine surfaces are available and these provide an excellent surface for painting and grain printing without additional filling.

Panels should have a primer or sealer coat applied; conventional wood priming paints are suitable. Water-based primers may cause the surface of the panels to swell slightly giving a textured surface which will not accept gloss finishes satisfactorily.

Flame retardant panels are available to meet reaction to fire Euroclass B or C requirements. If further coating is applied to these, the panel or paint manufacturer's advice should be sought as the coating may affect the reaction to fire properties.

If panel edges will be visible after completion it may be necessary to fill these with a wood or cellulose filler, sand with 180 grit paper and prime prior to the application of finish.

#### 4.7.9.2 Clear seals and varnishes

The surface pattern and colour of particleboards is naturally decorative and the application of a clear sealer or varnish can accentuate this.

For floors, a translucent or transparent flooring grade sealer will provide an excellent hard-wearing and decorative surface.

#### 4.7.9.3 Paper and fabric finishes

Particleboard can be faced with materials such as wallpaper, fabric or hessian. This is best done after the panels are fixed into place and joints between panels should be featured to avoid the potential for splitting or rucking of the finish as a result of slight movement of the panel due to changes in moisture content. It is advisable to seal the panel surface with an acrylic primer or sealer before applying the finish so that subsequent removal will be easier.

#### 4.7.9.4 Laminates, foils and veneers

Plastics laminates, foils and veneers can be bonded to particleboard without pre-treatment. Care is necessary to ensure that all materials have similar moisture contents and balancing laminates or veneers applied to front and back surfaces will generally be required to avoid panel deformation.

#### 4.7.9.5 Finishing flaxboard

Flaxboard can be veneered or faced with laminates in the same way as wood particleboard. It can also be painted and have vinyl or paper overlay applied, but it is not generally used in applications where these types of direct finishing are required.

### 4.7.10 Finishing OSB

#### 4.7.10.1 Opaque surface coatings

Oriented strand board can be painted with conventional oil-based and water-based paints applied by spray, brush or roller; textured coatings may also be applied. As water-based finishes cause slight increase of the surface texture and may, when the coating is applied to one face only, result in bowing due to moisture uptake, their use should generally be limited to situations where final appearance is not of paramount importance. Oil-based coatings are recommended where appearance is critical.

Where a high-quality finish is required, factory sanded panels should be used. When using unsanded panels it is necessary to rough sand the surface to remove any loose wafers and resin deposits before applying a surface coating.

Panels should have a primer or sealer coat applied, and conventional wood priming paints are normally suitable. Water-based primers may cause the surface of the panels to swell slightly giving a textured surface which will not accept gloss finishes satisfactorily.

Panels can be impregnated or surface treated with intumescent paint or varnish to upgrade surface spread of flame performance. If a further coating is applied, the manufacturer's advice should be sought as the coating may affect the reaction to fire properties.

If panel edges will be visible after installation, it may be necessary to fill these with a wood or cellulose filler, sanding and priming before application of the finish.

#### 4.7.10.2 Clear seals and varnishes

The surface pattern and colour of OSB is naturally decorative and the application of a clear sealer or varnish can accentuate this. If required it can also be coated with spirit-based decorative stain finishes. Factory sanded panels should be used and oil-based sealers and varnishes are preferred as these will not raise the surface texture.

For floors, a translucent or transparent flooring grade sealer will provide an excellent hard-wearing and decorative surface.

#### 4.7.10.3 Laminates and foils

Plastic laminates and foils can be bonded to factory sanded OSB without pre-treatment. Care is necessary to ensure that all materials have similar moisture contents; balancing laminates applied to front and back surfaces will generally be required to avoid panel deformation.

### 4.7.11 Finishing cement-bonded particleboard (CBPB)

#### 4.7.11.1 General

Due to alkalinity of the panels an alkali resistant finish is recommended. The advice of the panel or finish manufacturer should be sought.

Provided that a special primer is used, CBPB can be painted with conventional oil-based and water-based paints applied by spray, brush or roller; cement-based paints and textured coatings may also be used.

Before applying any finish, dust should be removed from the panel surface using a damp cloth and any holes or surface damage filled with a proprietary filler.

#### 4.7.11.2 Laminates, foils and veneers

Plastic laminates and veneers can be bonded to CBPB. Factory calibrated panels must be used and balancing laminates or veneers are required to avoid panel deformation.

Due to the panel's alkalinity, the manufacturer's advice should be sought with regard to suitable adhesives.

#### 4.7.11.3 Tiling

Before the application of ceramic tiles to CBPB, the rear face of the panel should be sealed using an approved sealer. The tiling adhesive used must be an elastic emulsion adhesive. Reference should be made to the panel manufacturer for specific recommendations. Further guidance can also be found in The Tile Association guidance (www.tiles.org.uk).

### 4.7.12 Finishing plywood

#### 4.7.12.1 General

As one of the few wood-based panels suitable for permanent use in exterior conditions, the requirements for finishing plywood are more complicated than for most of the other panel types. In interior conditions, most wood finishes are suitable for use on plywood, but the quality of the finish will be a function of the wood species and the quality of the surface veneer. A European guidance standard, *DD CEN/TS 635-4 Plywood. Classification by surface appearance. Parameters of ability for finishing, guideline*[8] gives guidance on the finishing of plywood in relation to the quality of the surface veneers.

Under exterior conditions, plywood will weather to a dull grey colour in the same way as unprotected solid timber. Further weathering can lead to a loss of fibre and checking and splitting of the surface. The application of a suitable finish before weathering occurs can protect the material and enhance its appearance. When used externally, all four edges of plywood should be effectively sealed with a suitable sealing compound.

#### 4.7.12.2 Opaque surface coatings

Plywood can be painted with most types of wood paints but some of these may be unable to tolerate the surface movements of plywood. Some water-based acrylic paints show high levels of extensibility and can tolerate these movements. However, dark colours of such paints should not be used in areas sheltered from rainfall as salt efflorescence can appear on the surface. Low-build exterior wood stains possess certain advantages over film-forming finishes by being more able to cope with the behaviour of exposed plywood. Exterior wood stains will not prevent surface checking but are less likely to flake off than paint. Redecoration with a stain will protect the checked surface and should maintain an acceptable appearance.

Flame retardant panels are available to meet reaction to fire Euroclass B or C requirements. If further coating is applied to these, the panel or paint manufacturer's advice should be sought as the coating may affect the reaction to fire properties.

#### 4.7.12.3 Clear seals and varnishes

The surface appearance of plywood can present an attractive finish and under interior conditions a clear sealer of varnish can accentuate this. For floors, a translucent or transparent flooring grade sealer will provide an excellent hard wearing and decorative surface. Under exterior conditions however, most of these unpigmented products do not offer protection from ultraviolet light and are not normally recommended.

#### 4.7.12.4 Wall coverings and paper overlays

In interior conditions, plywood can be decorated with the normal range of paper and fabric wallpapers.

Plywood is manufactured with a range of paper overlays to protect the panel and enhance its durability, to give a decorative finish or to facilitate painting.

#### 4.7.12.5 Laminates, foils and veneers

As with other wood-based panels, plywood can be finished with decorative laminates, foils or decorative veneers. In order to avoid distortion in service, care must be taken to ensure that the panel construction remains balanced (ie with an equal number and thickness of veneers with similar moisture movement characteristics either side of the core).

## 4.8 References


1 Stacking round timber, sawn timber and board materials. Safe working practices, HSE Woodworking Information Sheet No 2 (revision 2), HSE, www.hse.gov.uk

2 Handbook of Finnish plywood, Finnish Plywood International, 1991, ISBN 952-90-1976-9

3 Construction Products Regulation (CPR), Regulation 305/2011/EU

4 BS EN 14592. Timber structures. Dowel type fasteners. Requirements, BSI

5 BS 5385-1. Wall and floor tiling. Design and installation of ceramic, natural stone and mosaic wall tiling in normal internal conditions. Code of practice, BSI

6 BS 5385-3. Wall and floor tiling. Design and installation of internal and external ceramic tiling in normal conditions. Code of practice, BSI

7 Tiling to Timber Sheets and Boards, Timber Substrates and Alternative Products, The Tile Association, www.tiles.org.uk [At the time of writing, this document was being updated and may subsequently be published under a different title]

8 DD CEN/TS 635-4. Plywood. Classification by surface appearance. Parameters of ability for finishing, guideline, BSI

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