## 2.4 Application of panels in flooring

### 2.4.1 Selection of panels for flooring

The selection of wood-based panels for flooring depends on a number of factors of which the most important are:-

- the type of floor
- the load that the floor has to carry
- the ambient moisture conditions

It is convenient to recognise the following different **types** of floor

- **suspended floors** in which the floor decking is attached to a series of joists.
- **floating floors** in which the floor decking rests either on insulation above a structural sub-floor, or on a series of battens which has insulation between them. Note that in both situations the panel is load-bearing, as in event of failure, the underlying insulation is unlikely to be able to sustain the imposed loads..
- **overlays** which are attached to an existing floor (usually suspended) to improve the quality of surface or to reduce the transmission of sound.
- **raised access floors** in which the floor segments are supported on short pillars to permit access to cables below the floor.
- **industrial platform floors** which embrace both mezzanine and raised storage floors.

The selection of wood-based panels for the different floor types is set out in Tables 2.1 and 2.2.

The second criterion is the **load** that the floor has to carry. When designing a floor using permissible stress design, it is convenient to design the floor to one of three load classes:-

- **domestic** with a maximum UDL of 1.5 kN/m$^2$ and a maximum concentrated load of 2.7 kN/m$^2$
- **non-domestic light-duty** with a maximum UDL of 2.5 kN/m$^2$ and a maximum concentrated load of 2.7 kN/m$^2$
- **non-domestic heavy duty** with UDL and concentrated loads above 2.5 and 2.7 kN/m$^2$ respectively.

Comparable load classes for use with limit state analysis are given in Eurocode 1.

The selection of wood-based panels for floors subjected to domestic and non-domestic loading is given in Tables 2.1 and 2.2 respectively. It should be appreciated that the designer can design his floor to carry any specified load. More information on loadings for floors is provided in BS 6399 and Eurocode 1.

**Moisture conditions** will have markedly different effects on the performance of wood-based panels; these are quantified in terms of Service Classes as described in Section 2.3. The selection of panels for floors subjected to the different service classes is set out in Tables 2.1 and 2.2.

**Thermal performance**. Increase in the required level of thermal performance in the revised Approved Document Part L for England and Wales (with corresponding changes for Scotland and Northern Ireland) may result in the need to increase the thickness of panels above that necessary to sustain the imposed loads. Alternately, other materials with a higher thermal performance could be incorporated in the design in juxtaposition with the wood-based panel.

**Acoustic performance**. Similarly, the recent increases in the level of acoustic performance in constructions as set out in Approved Document Part E for England and Wales (with corresponding changes for Scotland and Northern Ireland) may result in the use of either increased thicknesses of wood-based panels, or additional materials such as mineral wool, acoustic felts and high density panels.

## TABLE 2.1 PANEL GRADES* FOR DOMESTIC FLOORS AND THE LOCATION OF DESIGN AND TESTING INFORMATION

| | DOMESTIC FLOORS | SERVICE CLASS | PLYWOOD EN 636 | PARTICLEBOARD EN 312 | OSB EN 300 | MDF EN 622-5 | FIBREBOARD EN 622-3,4 | CBPB EN 634 |
|---|---|---|---|---|---|---|---|---|
| Selection | **Suspended floors** | 1<br>2 | 636-1<br>636-2 | P4<br>P5 | OSB/2<br>OSB/3 | MDF.LA<br>- | MBH.LA 1<br>- | CBPB<br>CBPB |
| Design by Deemed to satisfy | | | BS 7916 has now been withdrawn (see 2.2.1.1) and the prescriptive relation between joist/batten spacing and panel thickness contained therein **must not be used**. Similarly the corresponding values for certain specified plywoods in BS 8103 Part 3 **must not be used.** | | | | | |
| **or** | | | | | | | | |
| Design by performance testing | | | Test using BS EN 1195 (see manufacturer's test data). Satisfy the requirements in BS 5268 Pt2. Design using BS 5268 Pt 2 (revised 2001). | | | | | |
| | or | | Test using BS EN 1195 (see manufacturer's test data). Satisfy requirements in EN 12871. Design using Eurocode 5 (ENV 1995-1-1) | | | | | |
| **or** | | | | | | | | |
| Design by calculation | | | **Using permissible stress design in BS 5268 Pt 2**. Stress and moduli are derived from the characteristic values in EN 12369 Parts1 and 2 except solid wood panels and CBPB: grade stresses and moduli for certain specific types of plywoods are also included in BS 5268 Pt 2 revised 2001. Alternatively, characteristic values for **all** load-bearing panels can be derived using EN 789 and EN 1058 and may be obtained from the manufacturers. Time modification factors for design are included in BS 5268 Pt 2 for all panels except CBPB. | | | | | |
| | or | | **Using limit state design in Eurocode 5 (ENV 1995-1-1)**. Characteristic values for all panels except solid wood panels and CBPB are given in EN 12369 Parts 1and 2; alternatively, characteristic values for **all** load-bearing panels can be derived using EN 789 and EN 1058 and may be obtained from the manufacturers. Time modification factors for design for all panels except CBPB are included in Eurocode 5, or an estimate of them can be derived using ENV 1156. | | | | | |
| Guidance on application | | | Guidance on the use of load-bearing boards in suspended floors is given in BS ENV 12872 | | | | | |

**TABLE 2.1 Cont.**

| | DOMESTIC FLOORS | SERVICE CLASS | PLYWOOD EN 636 | PARTICLEBOARD EN 312 | OSB EN 300 | MDF EN 622-5 | FIBREBOARD EN 622-3,4 | CBPB EN 634 |
|---|---|---|---|---|---|---|---|---|
| Selection | **Floating Floors** | 1 | 636-1 | P4 | OSB/2 | MDF.LA | MBH.LA 1 | CBPB |
| | | 2 | 636-2 | P5 | OSB/4 | - | - | CBPB |
| Design by performance testing | | Test using DD CEN/TS 13810-2 (see manufacturer's test data). Satisfy the requirements in BS EN 13810-1 (Note that the panels used as a floating floor should be of a load-bearing grade, as in the event of failure, the underlying insulation is unlikely to be able to sustain the imposed loads.) | | | | | | |
| Guidance on Application | | Guidance on the installation of floating floors is given in Annex B of EN 13810-1 for all panel types and in the WPIF Industry standard 2/1998 for particleboard and OSB; this is reproduced in PanelGuide as Annex 3 | | | | | | |
| Selection | **Overlays** | 1 | 636-1 | P4 | OSB/2 | MDF | MBH HB | CBPB |
| | | 2 | 636-2 | P5 | OSB/3 | MDF.H | MBH.H HB.H | CBPB |
| Guidance on Application | | The minimum thickness of panel is not specified on grounds that it is generally fully supported. The panels must be fixed to prevent lifting at the joints; consideration should be given to the provision of expansion joints. | | | | | | |

* 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

## TABLE 2.2 PANEL GRADES* FOR NON-DOMESTIC FLOORS AND THE LOCATION OF DESIGN AND TESTING INFORMATION

| | NON-DOMESTIC FLOORS | SERVICE CLASS | PLYWOOD EN 636 | PARTICLEBOARD EN 312 | OSB EN 300 | MDF EN 622-5 | FIBREBOARD EN 622-3,4 | CBPB EN 634 |
|---|---|---|---|---|---|---|---|---|
| Selection | **Suspended floors** | 1<br>2 | 636-1<br>636-2 | P6 (P4)<br>P7 (P5) | OSB/4 (3)<br>OSB/4 (3) | -<br>- | MBH.LA 1<br>- | -<br>- |
| Design by Deemed to satisfy | | BS 7916 has now been withdrawn (see 2.2.1.1) and the prescriptive relation between joist/batten spacing and panel thickness contained therein **must not be used.** | | | | | | |
| or | | | | | | | | |
| Design by performance testing | | Test using EN 1195 (see manufacturer's test data). Satisfy the requirements in BS 5268 Pt2. Design using BS 5268 Pt 2 (revised 2001). | | | | | | |
| | or | Test using EN 1195 (see manufacturer's test data). Satisfy requirements in EN 12871. Design using Eurocode 5 (ENV 1995-1-1) | | | | | | |
| or | | | | | | | | |
| Design by calculation | | **Using permissible stress design in BS 5268 Pt 2.** Stress and moduli are derived from the characteristic values in EN 12369 Parts 1 and 2 except solid wood panels and CBPB: grade stresses and moduli for certain specified plywoods are also included in BS 5268 Pt 2 revised 2001. Alternatively, characteristic values for **all** load-bearing panels can be derived using EN 789 and EN 1058 and may be obtained from the manufacturers. Time modification factors for design are included in BS 5268 Pt 2 for all panels except CBPB. | | | | | | |
| | or | **Using limit state design in Eurocode 5 (ENV 1995-1-1).** Characteristic values for all panels except solid wood panels and CBPB are given in EN 12369 Parts 1 and 2; alternatively, characteristic values for **all** load-bearing panels can be derived using BS EN 789 and EN 1058 and may be obtained from the manufacturers. Time modification factors for design for all panels except CBPB are included in Eurocode 5, or an estimate of them can be derived using ENV 1156. | | | | | | |
| Guidance on application | | Guidance on the use of load-bearing boards in suspended floors is given in BS EN 12872 | | | | | | |
| | **Industrial platform floors** | Specific information on mezzanine and raised storage floors is available in BRE Digest 437 | | | | | | |

**TABLE 2.2 Cont.**

| | NON-DOMESTIC FLOORS | SERVICE CLASS | PLYWOOD EN 636 | PARTICLEBOARD EN 312 | OSB EN 300 | MDF EN 622-5 | FIBREBOARD EN 622-3,4 | CBPB EN 634 |
|---|---|---|---|---|---|---|---|---|
| Selection | **Floating Floors** | 1 | 636-1 | P6 | OSB/4 | - | MBH.LA 2 | CBPB |
| | | 2 | 636-2 | P7 | OSB/4 | - | MBH.HLS2 | CBPB |
| Design by performance testing | | Test using DD CEN/TS 13810-2 (see manufacturer's test data). Satisfy the requirements in BS EN 13810-1 (Note that the panels used as a floating floor should be of a load-bearing grade, as in the event of failure, the underlying insulation is unlikely to be able to sustain the imposed loads.) | | | | | | |
| Guidance on application | | Guidance on the installation of floating floors is given in Annex B of EN 13810-1 for all panel types and in the WPIF Industry standard 2/1998 for particleboard and OSB; this is reproduced in PanelGuide as Annex 3 | | | | | | |
| Selection | **Raised Access** | Provided the performance requirements set out in pr EN 12825 are met, any panel product may be used. | | | | | | |
| Selection | **Overlays** | 1 | 636-1 | P4 | OSB/2 | - | HB.HLA2 MBH.LA2 | CBPB |
| | | 2 | 636-2 | P5 | OSB/3 | - | HB.HLA2 | CBPB |

* 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.

## 2.4.2 The design of timber floor decking

The various factors to be incorporated in design together with the now two alternative design concepts for floors were set out in Section 2.2.

The deemed to satisfy approach to the design of floors is **no longer valid**. Because of a change in the test methodology with the adoption of CEN standardisation and a consequential lack of test evidence to demonstrate compliance with the performance requirements of BS EN 13986, BS 7916 has been withdrawn. This means that the prescriptive specification linking panel thickness to joist/batten spacing in Table 4 of BS 7916 is no longer valid and must not be used. A similar situation for certain specified plywoods relates to BS 8103 Part 3. The means of demonstrating structural compliance with the CPD is now limited to one of the two methods described in 2.2.1.2 and 2.2.1.3. Those manufacturers that have carried out the new performance tests for floors described in 2.2.1.2 will be able to provide information on the panel thicknesses required to span various joist/batten spacings.

In the absence of "deemed to satisfy" information, recourse must be made to designing either by prototype testing, or by calculation as detailed in Section 2.2 and set out in Tables 2.1 and 2.2.

The typical board size for flooring is 2400 x 600mm, with other sizes available to order. The usual board width of 600mm makes handling in internal spaces easier and a length of 2400mm suits nominal framing centres of 600 or 400mm.

Boards may be plain (square) edged, or profiled. Plain edged boards need gaps to be provided between boards (see Section 2.4.3.6), and support to be provided by joists or noggings at all edges. Profiled edges are usually matching tongue and groove and remove the need to provide support at all edges on plain boards. For flooring purposes it is recommended that tongue-and-groove boards with glued joints are used to provide a smooth, stable substrate.

## 2.4.3 Sitework: Floor decking on joists

### 2.4.3.1 Conditioning

It is important that boards are installed 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.

### 2.4.3.2 Preparation of structure

The void beneath a joisted ground floor must be adequately ventilated to comply with the Building Regulations as well as with the requirements of NHBC.

Supporting joists, noggings and edge support should be laid to line and level.

Timber joists treated with water-borne preservative or which have high moisture contents should be allowed to dry to moisture contents less than 22% as water can migrate from wet joists into the boards and may cause localised swelling.
Access traps or ducting should be pre-planned and the necessary noggings and edge supports provided at all edges.

Joists and noggings should provide a minimum bearing for board edges of 18mm.

### 2.4.3.3 Laying – particleboard and cement bonded particleboard

T&G boards should be laid across the joists with both short edges supported on a joist, or other edge support (see Figure 2.2). Readers should note that additional materials (not

shown in the figure) may be required to meet other requirements eg. acoustics, thermal, reaction to fire

Square edged boards should be continuously supported along all edges, preferably by placing them with long edges along the joists and short edges supported by noggings (see Figure 2.3). They can be laid with short edges butted at joists and long edges supported by noggins but this method requires a greater number of noggings. Readers should note that additional materials (not shown in the figure) may be required to meet other requirements eg. acoustics, thermal, reaction to fire

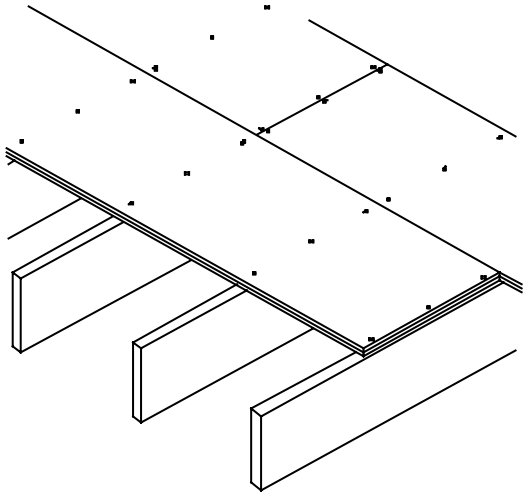

**Figure 2.2 Tongued and grooved edge structural decking should be laid across the joists with short edges supported on joists.**

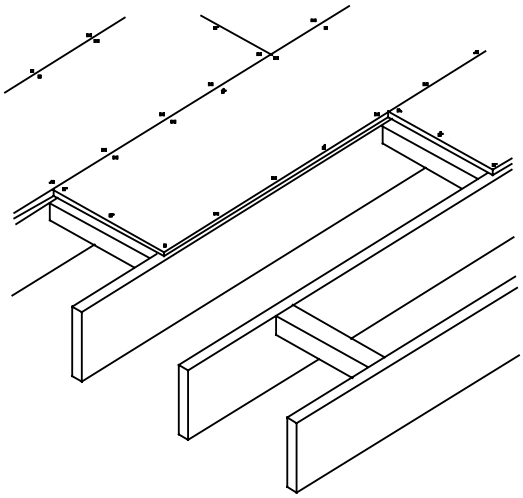

**Figure 2.3 Square edge structural decking (except OSB and plywood) laid parallel to the joists and supported at all edges.**

### 2.4.3.4 Laying OSB and plywood

There are two major but unrelated factors which affect the optimum performance of OSB and plywood joisted panel floors:

- **The method used to support the panels**

  Maximum strength and stiffness will be obtained if each panel is continuous over at least two spans between joists.

- **The composition of the panels**

  Most OSB and plywood panels have a predominately stronger and stiffer axis in either length or width and are laid to best structural advantage with the strongest edge spanning across the joists. If boards are not marked with the preferred laying direction, consult the manufacturers' technical data sheets.

T&G boards should have both short edges supported on a joist, or other edge support (see Figure 2.2).

Square edged boards should be continuously supported along all edges – short edges should be butted at joists and long edges supported by noggings (see Figure 2.4). Readers should note that additional materials (not shown in the figure) may be required to meet other requirements eg. acoustics, thermal, reaction to fire

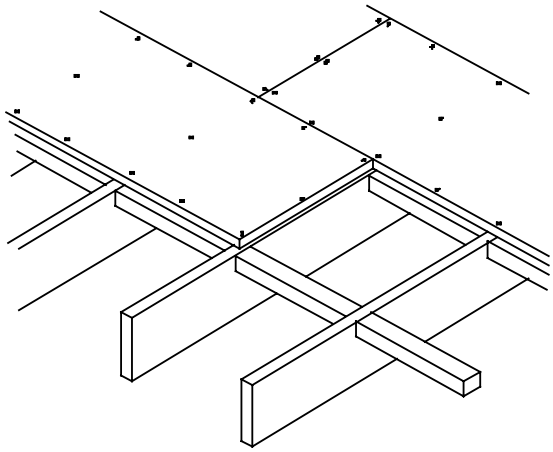

**Figure 2.4 Square edge structural decking laid across the joists and supported by noggings**

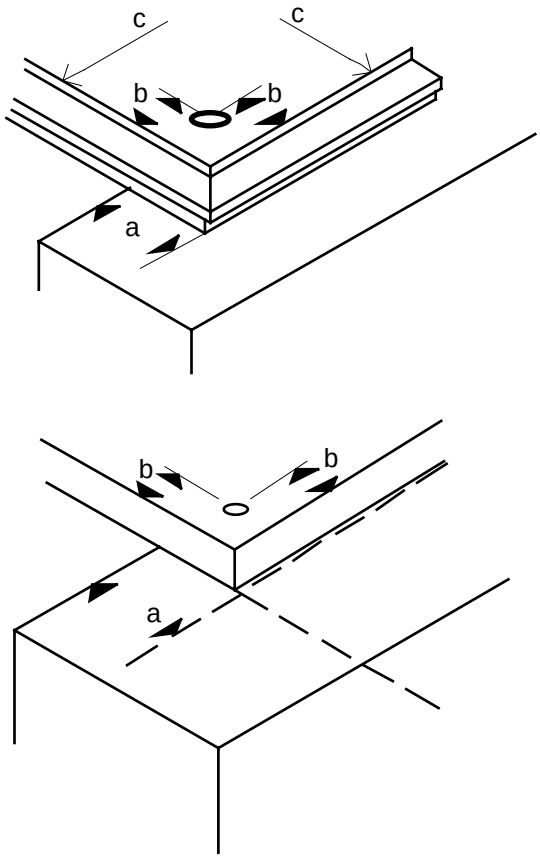


**Figure 2.5 A minimum edge nailing distance of 8mm should be maintained and a minimum bearing of 18mm provided to each board in both t&g panels (upper diagram) and square-edged panels (lower diagram).**

**a: bearing**
**b: edge nailing distance**
**c: face dimension of board**

### 2.4.3.5 All boards

All perimeter and cut edges on both t&g and square edge boards need to be supported on joists or noggings.

Boards should have a minimum bearing of 18mm on joists and noggings (see Figure 2.5).

Boards of both edge types should be laid to break joint i.e. with staggered short edge joints to avoid lining them up.

All joints in t&g panelled floors should be glued with a suitable PVAC adhesive (to BS 4071) or equivalent, to reduce the risk of creaking in use. It is further recommended that wood particleboard and OSB are also glued to supporting timber joists with PVAC adhesive.

### 2.4.3.6 Expansion gaps

A gap should be provided around the perimeter of a floor to upstands or abutting construction to allow for possible expansion of the decking. This should be a minimum of 10mm at each stage or 2mm per metre run of board. The gap should be left open and covered by a skirting board, or filled with a compressible strip such as cork. Larger floors may also need intermediate expansion gaps.

A 3mm gap should also be left between each square edged board.

For t&g boards or boards which by design are tightly butted, special attention must be given to fixing down to avoid buckling.

#### 2.4.3.7 Fixing

Boards should be fixed using corrosion resistant nails or screws. Corrosion resistant materials include galvanised or sheradised steel, austenitic stainless steel, phosphor bronze and silicon bronze.

Screws and flat headed improved nails (e.g annular grooved or ringshank) have superior holding power and should be used in preference to plain shank nails.

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

Screws should be conventional countersunk woodscrews or, where fixing to steel structural frames, self-drilling self-tapping screws.

The frequency and pattern of nailing to joists and noggings should be as set out in Table 2.3 unless structural calculations require otherwise. To avoid tear out at board edges, fixings should not be inserted closer to the edges than the minimum distances given, and as shown in Figure 2.3.

**Table 2.3 Spacings of fixings for floor decking**

| Panel type | Maximum spacings (mm) | | |
|---|---|---|---|
| | Perimeter Framing | Intermediate framing | Min edge distance (mm) |
| Particleboard | 150-300 | 300 | 8 |
| Cement bonded particleboard | see note | see note | see note |
| OSB | 150-300 | 300 | 8 |
| Plywood | 150-300 | 300 | 8 |

Note: For cement bonded particleboard recommended nail spacings and edge distances vary with thickness and from manufacturer to manufacturer – examples of nail spacing range from 200 to 400mm on perimeter framing and from 300 to 610mm on intermediate framing; nail edge distance varies from 15mm for boards less than 12mm and 20mm for thicker boards up to 25mm irrespective of thickness. Boards may need to be pre-drilled or fixed with self-drilling screws to avoid splitting. For fixing cement bonded particleboard it is therefore essential to obtain and follow the manufacturer's recommendations.

All nail heads should be punched home by 2-3mm. Screws should be countersunk.

Where manufacturer's instructions are supplied with the boards their recommendations should be followed.

After fixing, board surfaces should be protected from damage and the treading in of grit and debris during building works with building paper/polythene. Heavily trafficked areas should be protected with a temporary board covering.

## 2.4.4 Sitework: Floating floor decking

Guidance on the installation of floating floors is given in the WPIF Industry standard No.2/1998 for particleboard and OSB which is reproduced as Annex 3, and in Annex B of BS EN 13810-1 for all board types.

## 2.4.5 Finishing

Particleboard floors provide a smooth flat surface which is suitable for many types of floor covering, provided that the fixing, edge support and gluing recommendations are followed. OSB boards have a surface texture which shows the shape of the wood strands – boards produced for use as flooring have a smooth sanded surface.

### 2.4.5.1 Carpet and sheet floorings

Where carpet is to be laid over particleboard and held in place using pre-nailed carpet gripper, adequate edge distance must be left for the gripper nails to avoid splitting the boards.

Sheet flooring can be loose laid or bonded directly to the board surface.

Thin sheet flooring or thin carpet may allow the board joints beneath to show through, particularly after trafficking.

### 2.4.5.2 Tiles

The application of rigid ceramic tiles to wood-based boards which move in response to changes in relative humidity requires great care in specification and site practice to avoid cracking at joints or through tiles. Further information is provided in Section 4.7.5.

### 2.4.5.3 Adhesives

Most common floor laying adhesives are suitable for use with wood-based boards; however, water-based adhesives should not be used unless they have a very low water content or the board surface is sealed with a suitable sealer. This will prevent excessive amounts of water which may not be able to evaporate through the floor covering being absorbed by the board, causing swelling and/or distortion if present in sufficient quantities.

### 2.4.5.4 Sealers and surface finishes

Boards are available pre-finished with a surface seal. Boards may also be site finished with surface coatings to give temporary protection or to give a fully treated decorative finish.

Cement bonded particleboard surfaces must be primed with an anti-alkali primer before decorating or applying coverings, unless alkali resisting products are being used.

Most types of internal and external paints and stains may be used, in accordance with the manufacturers' instructions. Water-based paints may be used on wood chipboard and OSB but may cause unacceptable raising of grain and increase the risk of unacceptable movement and/or distortion.