

## Timber Flooring

### SCOPE

Timber floors are suitable for use in a wide range of both commercial and domestic applications. The properties of timber offer qualities unlike any other material – flexible in its application, durable yet not harsh underfoot along with a wide range of colours and attractive features. Timber floors have proven performance from the ballroom through to the warehouse. The range of products allows applications over timber floor frames, on battens over slabs or even directly to the slab surface.

The following information describes common timber floor systems along with various issues such as grade, size, colour and fixing requirements.

Figure 1: Tongue and groove flooring

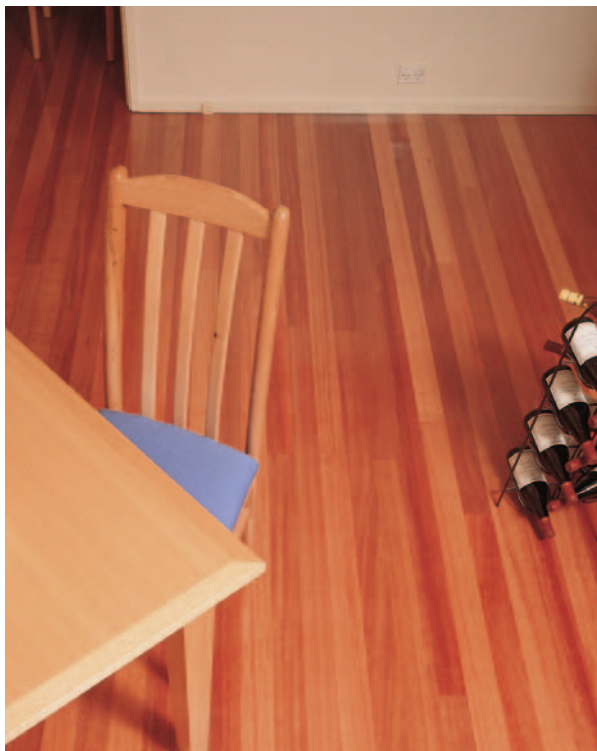
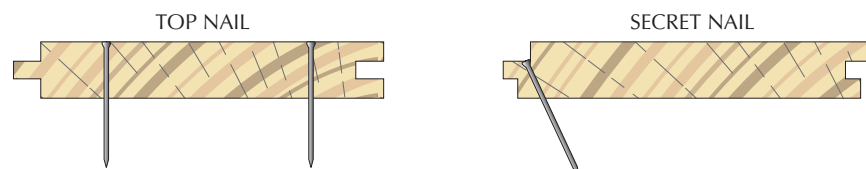


Figure 2: Typical tongue and groove profiles



### FLOORING SYSTEMS

There are four common floor systems, tongued and grooved, overlay, parquet, and structural plywood (veneer faced) flooring.

#### Tongue & Groove (T&G) Flooring

Tongue and groove flooring utilises lengths of solid timber boards. The boards are generally 19mm thick and range in width from 60 to 150mm. T&G boards are generally laid over a timber sub-floor (joists), but can also be laid over concrete slabs (directly, or on timber battens, or on plywood) or over timber sheet or strip flooring.

Each board has a protruding ‘tongue’ along one edge and a machined groove along the other so that each board fits into the adjoining board. The ends of boards can also be machined with a tongue and groove profile termed ‘end matched’. End matched boards allow the end joint to occur randomly rather than over joists or battens thus improving installation efficiency, saving most docking of boards and resultant wastage of material on site as required with butt joints.

T&G board profiles include face-nail and secret-nail designs. Face (or top) nailing describes driving nails through the top face of the board into the substructure. Where the floor is to be sanded and polished, the nails are punched below the board surface and the resulting hole is filled with a suitably coloured filler. Secret nailing describes fastening through the tongue of the board into the substrate. Each subsequent board then effectively conceals the nailed tongue of the proceeding board. The face of the board is left unblemished. Secret nailed board width is limited to 85mm as only one nail is used to secure the board at each joist. (Refer to Figure 2). For wider boards a combination of nailing and adhesive may be acceptable.



## Overlay & Floating Timber Floor Systems

Overlay and floating timber floor systems are non-structural, meaning they rely completely on the substrate over which they are installed for support. Some products are backed with or installed over a resilient layer, providing a degree of cushioning and sound insulation. Others may be fixed or adhered directly to the substrate. The term 'floating' floor relates to those products which are not fixed directly to the substrate.

Generally these products can be divided into plywood based, MDF cored and solid timber systems. The plywood version has a face veneer with the remainder of the product made up of (typically) softwood veneers. Some may also have a layer of hardwood as the bottom layer of the plywood configuration. This gives it balance and results in a more stable product. Milled solid timber is also available as an overlay system. The lengths of the individual boards are typically shorter than those found in conventional floor boards. Some are supplied pre-finished whilst others require sanding and finishing on site.

Adhesive fixed T&G flooring is available in thicknesses ranging from 12 to 19mm. These boards are attached directly to the substrate surface with adhesive. The tongue and groove is generally set towards the lower portion of the board, particularly in the thinner variations. This allows additional timber thickness above the tongued and groove joint to cater for sanding for both initial and maintenance sanding where required. Some products are pre-finished, others are sanded and coated on-site.

Figure 3:  
*Adhesive fixed tongue and groove flooring*

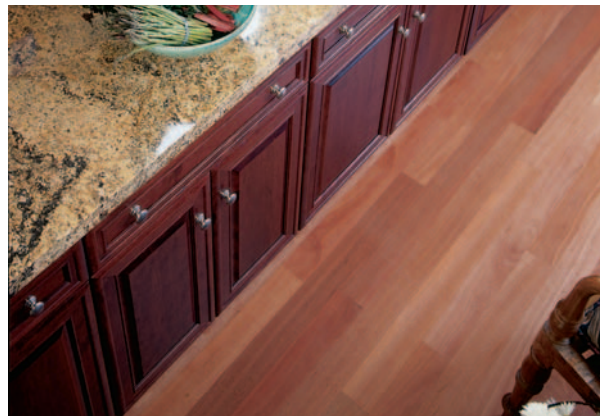


Figure 4: *Floating timber plywood floor*



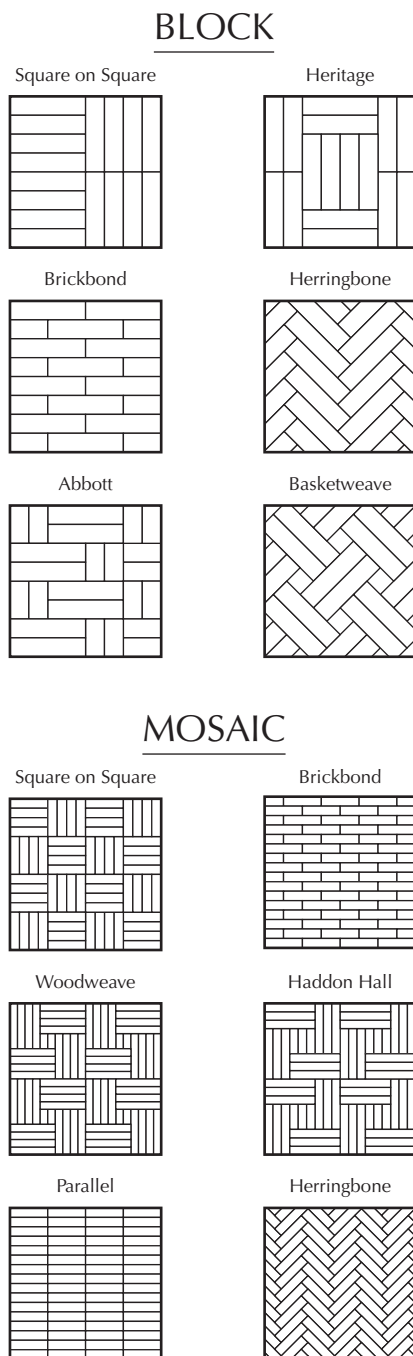
Figure 5: *Feature veneer plywood overlay flooring*



## Parquet

Parquet is a system of timber flooring that comprises small blocks of timber, laid in one or more of a variety of patterns from simple block to highly intricate basket weave. (Refer to Figure 3). The range of patterns available is almost limitless and may be further enhanced by mixing various species or introducing contrasting borders. Inlays of other materials such as granite, ceramic tiles, etc., can also be incorporated.

Figure 6: Popular parquet patterns



## Structural Plywood Flooring (Decorative Veneer Faced)

Structural plywood flooring comprises a plywood base with a decorative hardwood face veneer. It has the capacity to be installed as a structural floor spanning between joists or battens, or fully supported on a continuous substrate (e.g., concrete slab), in the same manner as an overlay floor. There are both sheet and plank type products, joined either with a plastic tongue which fits into a groove in the edge of the material, or a more conventional milled tongue and groove joint. For span capacity and the specific fixing requirements, refer to the producer's instructions.

The face veneer thickness varies between producers. The thicker this top face veneer is, the better the ability to be re-sanded and finished. Unlike conventional strip flooring no 'level' sanding is required in the initial finishing process.

Figure 7: Structural plywood flooring with decorative veneer face





## TIMBER FLOOR CHARACTERISTICS

### Species and Colour

There is a large variety of timber species, colour and features available in hardwood flooring. Table 1 lists timber species into broad colour groups.

Since timber is a natural product, it may have a wide variety of natural features and colour variation within the one species. Every floor will be unique and may well vary from timber samples or showroom displays. Refer to Timber Species Guides for detailed descriptions of each specie.

Sapwood of many native species is much lighter in colour than the adjacent heartwood.

Some manufacturers may also group a number of similarly featured species together and give that grouping a marketing name unique to that supplier. Where this is the case, reference will need to be made to the producer or supplier to nominate these species if required.

Hardness indicates a species' resistance to indentation and abrasion. Damage to timber floors may arise from heavy foot traffic, stiletto heels, the moving of furniture and the like. The Species Guide for Hardwood and Cypress includes a 'Janka' rating of all timbers listed. The higher the rating number the more resistant the timber is to indentation and abrasion. As a general guide:

Janka Rating	
<5.5	Soft
5.5 - 7	Moderate
7 - 10	Hard
>10	Very Hard

Table 1: Colour group of common flooring timbers

Colour Group	Timber Species
Blond	Ash (Silvertop, Mountain and Alpine), Blackbutt, White Mahogany
Brown	Brushbox, Grey Box, New England Blackbutt, Spotted Gum, Stringy Barks (Yellow, Red, Silvertop)
Yellow	Cypress, Tallowwood
Red	Forest Red Gum, Flooded Gum, Grey Gum, Red Ironbark, River Red Gum, Sydney Blue Gum, Turpentine

### Timber Flooring Grades

Milled timber products such as tongued and grooved flooring and parquet are graded in accordance with the amount of naturally occurring features such as gum vein, tight knots, checks (thin shrinkage cracks), borer holes etc. The allowances for each of the grades is set out in Australian Standard AS2796.2 Timber Hardwood – Sawn and Milled Products – Grade Description for Hardwood, and AS1810 Seasoned Cypress Pine – Milled Products.

These features do not impact structurally on the product, and offer a uniqueness and character to the material.

There are four grades under the hardwood standard;

- Select Grade – minimum amount of features.
- Medium Feature Grade – medium amount of features.
- High Feature Grade – high proportion of features.
- Parquet Clear – generally clear of features.

Cypress Pine has two grades:

- Grade 1 – medium amount of features.
- Grade 2 – high proportion of features.

APPLICATIONS

In addition to the above mentioned grades, the producers of timber products may also have their own trading names for their products, and in many cases these products have been graded in accordance with the standard.

Figure 8: Gradings for hardwood flooring

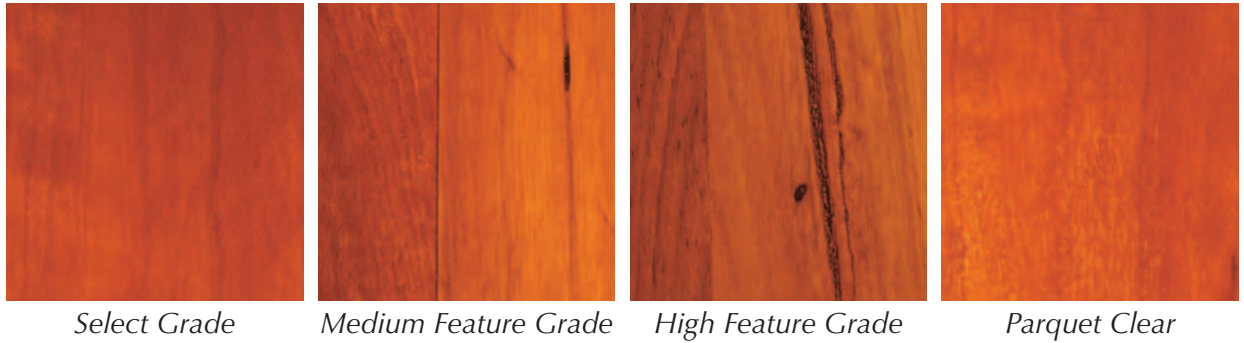
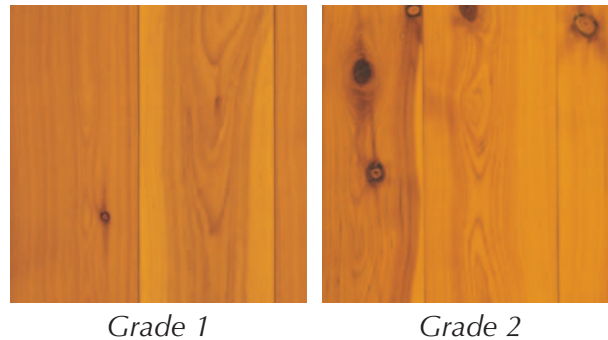


Figure 9: Gradings for Cypress flooring



## MOISTURE CONTROL

Timber is a natural product and ‘hygroscopic’ This means that its moisture content will vary to equalise with changes in humidity of its surroundings. As it varies to remain in equilibrium with its surrounding atmosphere, it will either expand as it absorbs moisture, or shrink as it loses moisture. Generally, the wider the individual boards, the greater is this movement. Gaps of 1mm between boards are not uncommon, particularly during drier months, and often closing during wetter months. Large windows, heaters and other heat sources will influence the moisture content in a floor. The heat source may lead to localised movement such as in front of a heater. In elevated floors, the underside of the boards may need to be sealed or protected.

An alternative method of protection in these elevated floors, is to fix the flooring over a sheet flooring substrate. Neither of these precautions will provide a suitable solution or

protection where the sub-floor conditions are constantly damp. In these situations the cause of the dampness must be resolved via good drainage and ventilation.

It is recommended that timber flooring be installed at the average equilibrium moisture content of that environment. Typically timber floors are supplied with a moisture content suitable for normal conditions in most locations. Particular environmental conditions such as air conditioning, heated concrete slabs etc., may require boards specified to a lower moisture content than those in a non air conditioned environment.

It may be necessary to acclimatise the timber to the service conditions. This may be achieved by exposing the timber to the room’s normal operating environment for a period of two weeks or more. For further information refer to the Hardwood and Cypress Technical Guide.

Where timber flooring is installed on joists in a ground floor situation, the sub-floor



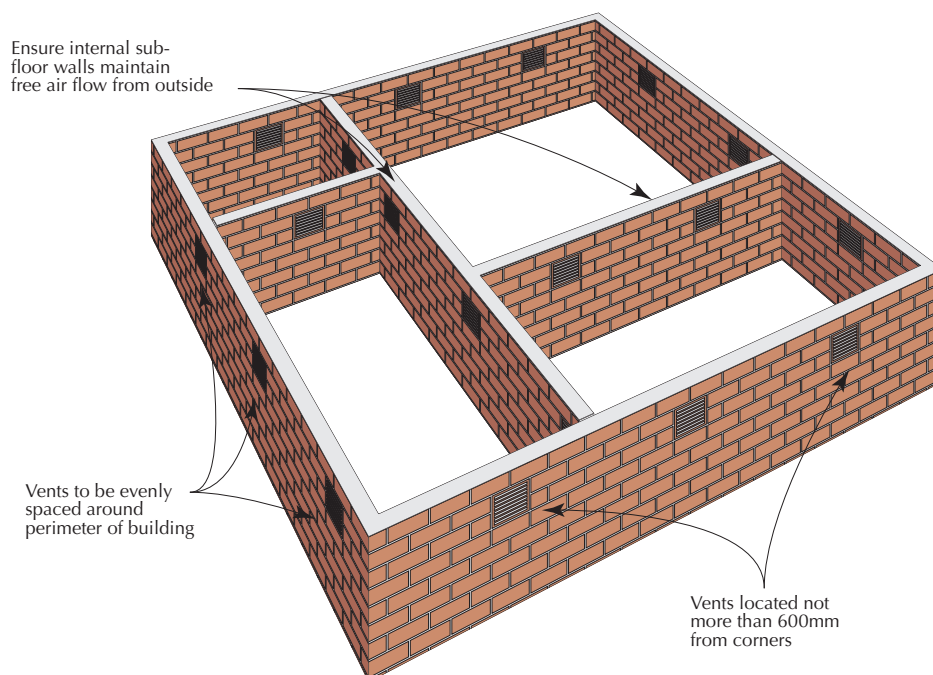
environment may impact on the timber flooring. An assessment of the ventilation, sub-soil dampness and site drainage should be made. Where the sub-floor conditions are moist, the boards, being exposed to these conditions, will absorb the moisture. Large percentage changes in moisture content will impact upon floor performance.

For timber floors over a concrete slab, moisture commonly comes from the slab. Recently constructed slabs or slabs on the ground are likely to have high moisture content. For these conditions it is imperative to ensure the slab is suitably dry (typically 5.5% moisture content) before the floor is installed. New concrete slabs may take many months to dry, typically 1 month per 25mm thickness of slab, plus 1 month is a rough rule of thumb. Therefore, deep beams, edge thickenings, etc., will consequently take longer to dry. The actual moisture content should be confirmed via appropriate moisture measuring equipment. The testing regime should take into account such variations in slab thickness.

Many older slabs in ground contact, although dry, may be porous.

It is often best to assume the slab on ground is not dry or that it may be porous, and to install a vapour barrier between the slab and the timber.

Figure 10: Sub-floor ventilation to low level floors



## EXPANSION OR CONTROL JOINTS

Expansion or control joints are required to allow for the potential movement of timber floors (caused by fluctuations in moisture content) during normal service condition.

Generally, for floors up to 6m in width (measured at right angles to the boards), simply leaving a clear gap of 10mm between the floor edge and any structure will suffice. For continuous floor widths over 6m, intermediate expansion joints (parallel with boards) should be provided in addition to the minimum 10mm perimeter gaps. These joints can be either a single 10mm wide gap potentially located under a wall or across a doorway leading to a hallway and the like, or smaller gaps with closer spacing to give an equivalent total gap, for example a series of 1mm gaps at 1m spacings.

Where expansion joints occur in timber floors spanning between supports, it is recommended that a nogging be installed under the tongued and grooved joint to provide support.

## ACOUSTICS AND TIMBER FLOORING

In multi-storey construction, timber floors along with all other hard floor surfaces raise potential issues of impact noise on the lower level or, in the case of units, adjoining dwellings. The key to improving the performance is through isolating the floor surface from the sub-structure. This is generally achieved with the use of an acoustic underlay or pads. Additionally the use of an acoustically isolated ceiling in the room directly beneath the hard surfaced floor will further reduce noise transmission.

Figure 11 and 12 detail suitable approaches for improving acoustic performance for various timber floor systems.

Depending upon the type of timber floor selected, the floor could be fixed directly over a suitable underlay. Where a conventional strip floor is required, the process involves the acoustic underlay, then a plywood sheet (min 12mm) followed by the strip flooring – secret nailed.

Figure 11: Acoustic isolated floor systems

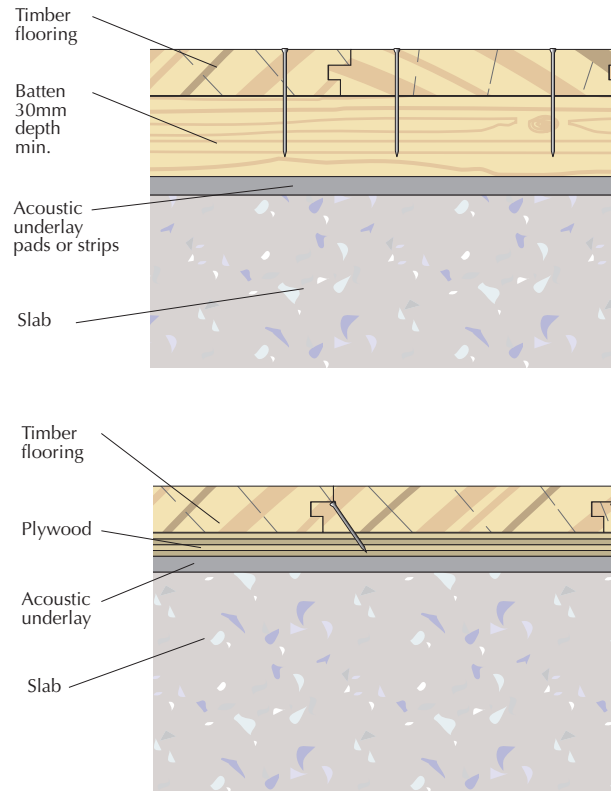
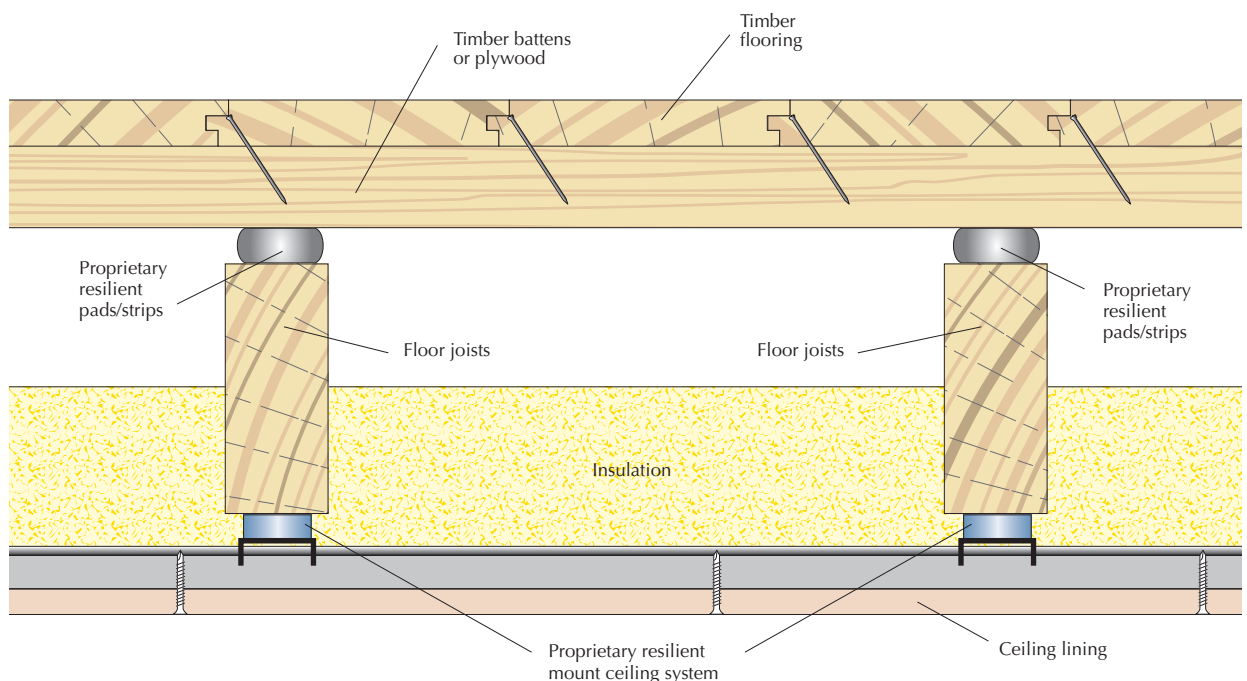
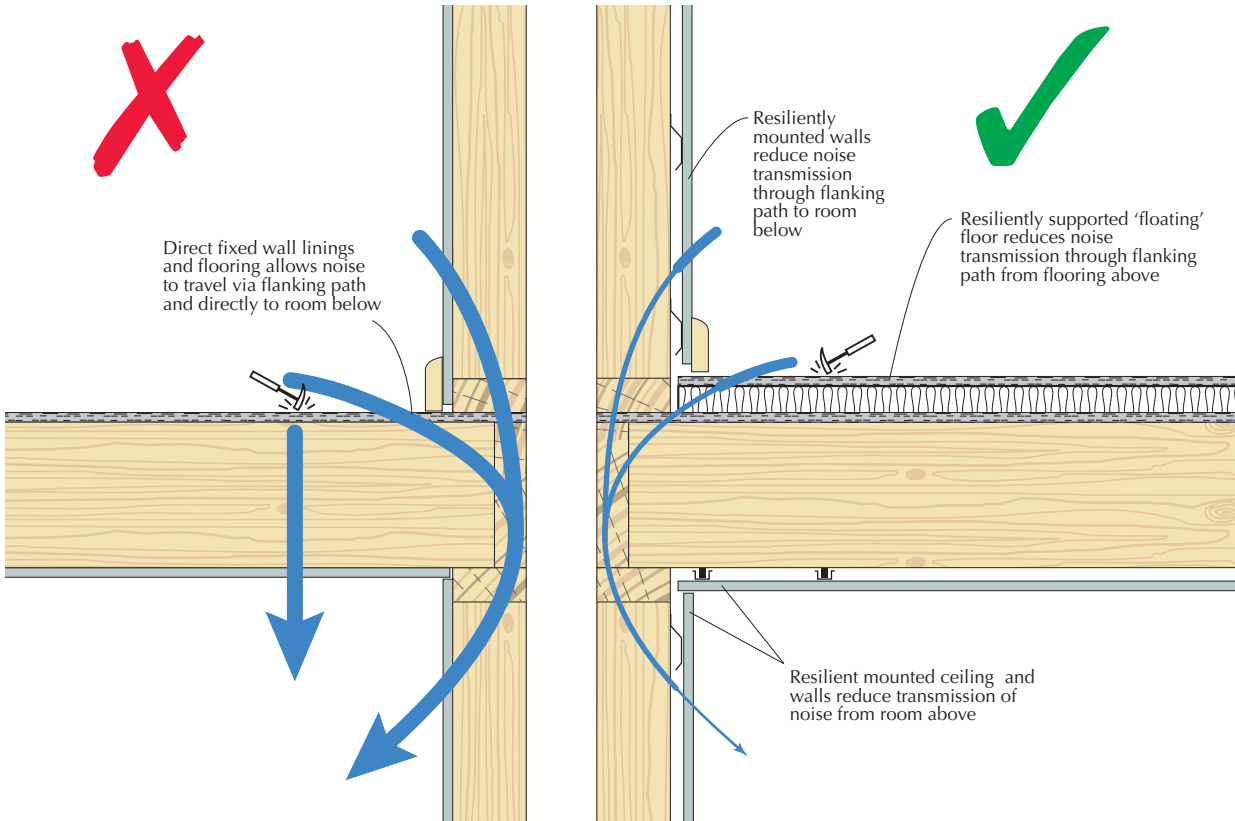


Figure 12: Acoustic isolated floor and ceiling system for timber frame substructure



Care must be taken not to 'bridge' the floor to any other structure i.e. walls, columns etc.  
Refer to Figure 13.

Figure 13: Acoustic management of sound transmission





APPLICATION GUIDELINES

## INSTALLATION CONSIDERATIONS

### Tongue and Grooved Timber Floors

T&G timber floors may be fixed to a variety of substrates including timber and steel joists, and to battens or plywood over a concrete slab. Depending on board width and profile they may be either secret nailed (where the nail is installed within the T & G joint and effectively hidden from view), or top nailed.

For T&G timber flooring installed on a suspended timber or steel framework, the nailing requirements are as per those specified in AS1684 – Residential Timber Framed Construction. The flooring forms an integral part of the framework of the building. It must also have the capacity to span between the joists, with consideration being given to the loads imposed, i.e. commercial loadings or residential loads. Refer to Table 2 for spanning capacity of 19/20mm flooring.

### Parquet

Parquet is installed directly onto the supporting substrate. The parquet pieces are glue fixed to the substrate in the desired pattern. Key issues for parquet installation include:

1. Slab moisture content: Typically, when tested with suitable measuring instruments, the slab moisture content should measure no higher than 5.5%. Refer to Moisture Control previously discussed.
2. Substrate tolerance: No more than 5mm below a straightedge of 3m length, and no more than 1mm below a straight edge of 150mm. Where the slab surface does not meet these requirements it may be either ground or topped with a suitable levelling compound.
3. Adhesive: The adhesive must be suitable for the purpose. It must be applied at the appropriate rate, with a notched trowel. Care must be taken to ensure that parquet can be laid before the adhesive skins or becomes unworkable.
4. Expansion joints: Expansion joints may be necessary in large areas of floor to allow for some natural moisture driven movement in timber. This movement is across the grain and hence does not impact on the length of the parquet pieces but rather their width. Brick block type laying patterns are the most affected as all the movement will be in the same direction, perpendicular to the length of the parquet blocks. An allowance for movement, typically no less than 10mm, should be made at wall or other structures such as a tile/parquet interface.

Table 2: Span capacity of T&G flooring for residential loadings

Timber	Density kg/m <sup>3</sup>	Grade	Thickness (mm)	Maximum Support Spacing (mm)	
				Butted over joists	End matched
HARDWOOD AS2796	400 to 560	Medium Feature and Select	19	510	390
	561 to 720	Medium Feature and Select	19	580	450
	721 plus	High Feature	19	580	450
Medium Feature		19	640	490	
CYPRESS AS1810		Select	19	680	520
		Both grades	20	580	450

### Timber Flooring Fixed over Concrete Slab

Timber flooring over a concrete slab can be fixed by means of a sheet floor underlay, typically plywood (12mm minimum thickness), or seasoned timber battens (typically 19mm hardwood). The flooring is then installed in much the same way as for floors on timber joists.

The boards are usually secret nailed in these applications. Where top nail fixing is required, the batten needs to be a minimum of 30mm in thickness to accept the nail. Plywood is not suited for top nailed installations over concrete.

Note: It is good practice to install a vapour barrier (plastic membrane type) over the slab before installing either battens or plywood sheeting. This is a low cost and reasonably effective barrier which will assist in lowering the impact of slab moisture.

Substrate tolerances for a slab surface which supports tongued and grooved flooring fixed to plywood or battens is greater than those allowed for parquet flooring. The acceptable limit for this type of application is a tolerance of 3mm below a 1.5m straight edge. Where tolerances do not meet these requirements, the slab surface may need to be either ground level or topped with an appropriate levelling compound.

Figure 14: Fixing layout for plywood under T&G flooring

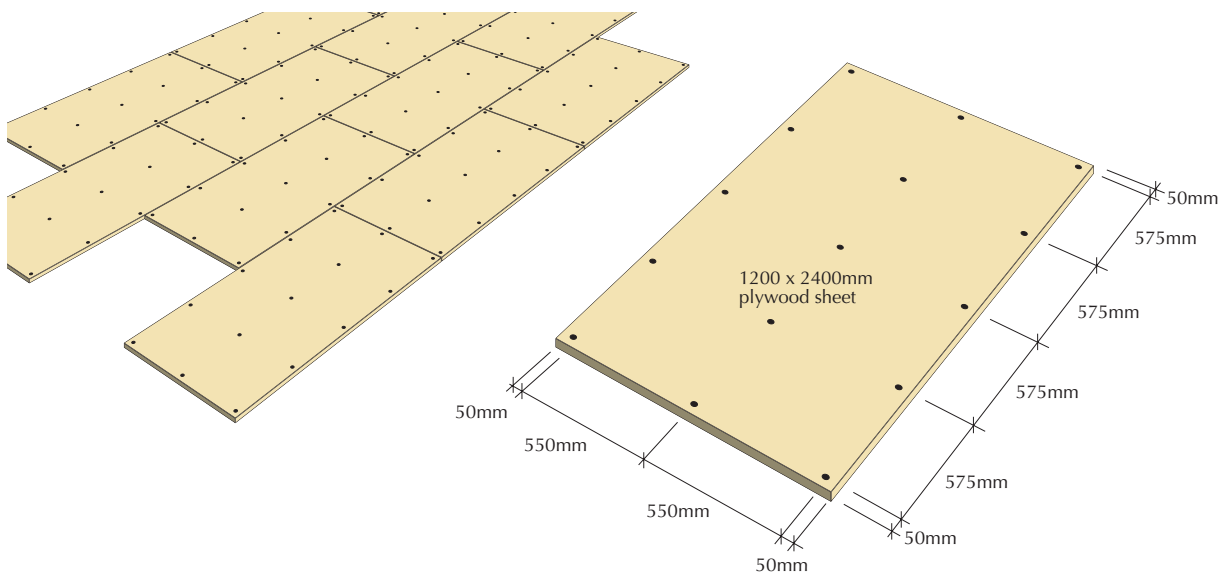
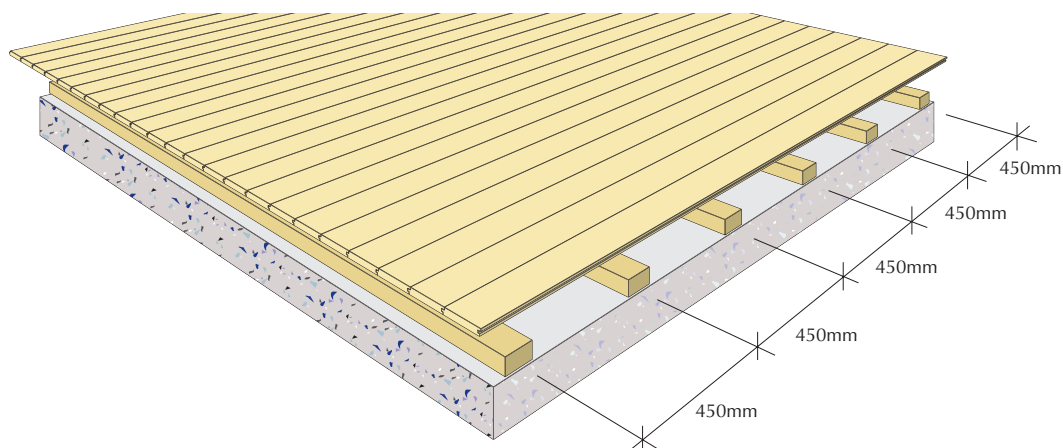


Figure 15: Fixing layout for battens under T&G flooring





APPLICATION GUIDE

## T&G Flooring Fixed over Particleboard

T&G flooring fixed over particleboard requires special attention as the particleboard does not provide a suitable base for effective nailing. Acceptable fixing methods are either: nailing through the particleboard into the supporting floor joists so that the nail is adequately embedded into the joist, normally 10 x nail diameter; or alternatively fully glue fixing the boards, generally in association with secret nailing.

Typically, the particleboard will require a light sanding to remove peaked joints and to enhance adhesive bond. Care must be taken to ensure that the moisture content of the particleboard is not above that of the flooring. In many cases the particleboard may have been exposed to the elements during construction and may not have dried sufficiently.

## Overlay Timber Floor Systems

Overlay timber floor systems may be fixed in a variety of ways. Some are not fixed directly to the substrate, but rather, each panel or board is fixed to adjoining boards/panels. Some are partially fixed, others are fully glue fixed. In all cases follow the manufacturer's fixing instructions. These flooring system are not structural, and are laid directly over the substrate. Acceptability of the substrate in terms of level, integrity and moisture content is critical for their long term performance. Typically, constraints placed on overlay floor systems are similar to those for parquet systems.

## FINISHING SYSTEMS

There is a broad range of finishes available for timber floor systems. These can be broken into the following categories:

- Oil-based finishes – tung oil, modified tung oils, penetrating oils.
- Polyurethanes – solvent-based – single and two pack.
- Polyurethanes – water-based.

The selection of a suitable finish is based upon aesthetics, wear characteristics, maintenance and the ability to accommodate minor board movement.

## Solvent-based Polyurethanes

Solvent-based polyurethanes are hard wearing, available in a range of gloss levels and are fairly quick drying. They have a tendency to physically glue the boards together when the coating works its way between the boards. The ramification of this is clearly apparent when the boards shrink slightly as atmospheric conditions become drier. The result is small groups of boards moving as one, producing a large gap, then another group of boards move as one, and so on. This is known as edge bonding, edge gluing, clumping or rafting. In extreme cases a board may be split as a result.

## Water-based Polyurethanes

Water based polyurethanes are not quite as hard wearing as the solvent based variety. The product is gaining in popularity due to its rapid drying and very low odour. The propensity for edge bonding is lower than with the solvent based variety.

## Oil-based Finishes

Oil based coatings are typically finished with a polish. The maintenance is higher than for the polyurethanes, and generally the gloss level is not as high as those achieved with the solvent based polyurethane product. Oil based finishes have a low propensity for edge bonding problems.

In all cases, the quality of the finish for timber floors will generally rely on the skills of the contractor. The sanding operation levels the floor surface, with a staged approach, starting with coarse paper and finishing with a very fine grit. The sanding should be uniform without any obvious grooves or swirl marks.

The coating of the boards shall follow the instructions of the manufacturer of the finish product. In all cases it is imperative to minimise any potential for dust or other foreign matter to contaminate the coating during its application. The floor will incur some minor blemishes to the finish over the years and can be expected to develop a softened patina.

RELATED DOCUMENTS**(From this Series of Timber Development Association Publications)**

- Fire Requirements for Non-Domestic Fit-Out (including information on BCA requirements for fire and other issues).
- Technical & Detailing Guide for Hardwoods and Cypress (including information on moisture management, durability, appearance and structural issues).

ACKNOWLEDGMENTS

- Timber Manual, National Association of Forest Industries Ltd., Canberra.



For additional assistance please contact the  
Timber Advisory Service

**1800 044 529**

or visit the following websites:

[www.timber.net.au](http://www.timber.net.au)

[www.australianhardwood.net](http://www.australianhardwood.net)



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