**Introduction**

Timber floors, being solid T&G, engineered, laminate or bamboo, may all experience water damage at some stage in their life. Damage from water can result from an event such as a flood or cyclone, or just more extreme wet weather. Other sources of water damage can include building leaks, burst dishwasher, fridge water, laundry pipework or simply an overflow from a bath or tub. The water may affect a limited area or full inundation may have occurred. It is therefore important to have an understanding of how the many different types of timber flooring products will react, in order to determine whether the floor can be saved or will need to be replaced. In addition to this, we are also starting to see accelerated drying processes being used and in some instances floors being saved that would otherwise have been replaced. This information sheet will discuss water damage to floors and will outline what needs to be considered with regard to repairing or replacing a water damaged floor.

**Water and wood – some things we need to understand**

Firstly, both the timber species density and the duration that the flooring has been wet are factors that must be consider. The general principal here is that low density (light) timbers take up and lose water fast, whereas high density (heavy) timbers take up and lose water slowly. This requires due consideration. The graph shows trial results from some years back when decking timber samples were placed outside in the weather. The graph shows sample board moisture contents when tested on certain days. On 11 February, after becoming rain wet but with a dry deck surface, the low density Radiata pine had reached over 20% moisture content while high density Spotted Gum and Blackbutt remained at 11% and 12%. To illustrate this further, you can simply get a piece of Radiata pine and a piece of Spotted Gum (i.e. low and high density woods) and submerge both in water. A quick trial indicated that after 4 hours the pine increased in weight by about 40% and the Spotted Gum by just 2%. Pine floors will absorb moisture quickly but are also quick to dry. If a higher density hardwood floor gets inundated with water for say 4 hours, this will cause only a small amount of moisture uptake. However, if the high density hardwood is sitting on wet pine plywood or particleboard for a number of weeks, or there is a slow water leak that is not discovered for weeks or months, then that hardwood floor will absorb significant amounts of water and also take a long time to dry. So the species of flooring installed, as well as the duration of wetting are two important aspects to be considered.
Floor types and their response to being moisture affected

Floor type is the next aspect to be considered and closely linked to this is subfloor type, as will be discussed in the section below.

The traditional timber floor was solid T&G timber flooring, top nailed into joists and this flooring system, when higher density hardwoods were used, was very robust to the effects of becoming wet. In fact these floors in the early days were laid weather exposed and many still remain as exposed appearance floors today. It was however, a little ‘hit and miss’ in terms of aesthetic appearance and weather exposed laying is no longer done. It is also less common to see solid timber floors laid direct to joists these days, but as we know, this type of flooring is now laid over many different types of subfloors.

When it comes to engineered flooring, bamboo and laminate these are mainly overlay flooring products and therefore are tied into being laid over a structural subfloor. All these products can be laid as floating floors and when laid in this manner, either a section of the floor or the whole floor can usually be more easily replaced and this is what generally happens when water affected. The cost of a floated floor may also be at the lower end of the scale, making replacement the most feasible option, whether in part or full. If a section of the floor is to be replaced then being able to source the same or very similar product can be difficult, or not possible to achieve and this also needs to be considered and has resulted in full replacement. One other aspect to consider with this, is the age of the installed flooring as after say 10-20 years, the condition of the floor may have deteriorated to the point where replacement is the prudent option. As such, remedial work that does not result in either replacing either some or all the floor is much less common, but may occur if the affected area is small and the effect of the water damage is also small.

Both engineered and bamboo floors can be adhesive fixed to subfloors and this makes replacement more difficult and remedial work after being moisture affected becomes a greater consideration. However, it is important to note that not all products are suitable for the remedial work that would be necessary. For example, engineered flooring with a thin face veneer, or lamella as it is also referred to, would not be suitable for re-sanding. With both engineered and bamboo flooring water can also cause severe discolouration, as shown in the photo, also necessitating that at least affected boards be replaced. However, there have been times and depending on the extent of the water damage, that repair has been the preferred option, which may require replacing some flooring and then re-sanding and coating throughout.

Subfloor considerations are equally as important

As indicated above the subfloor is also an important aspect to be considered with water damaged floors. Solid timber floors direct to joists are usually the least affected and this is particularly so if the building has good subfloor ventilation. Higher density hardwood floors have often absorbed little moisture, soon after an event they have conditions that will enable the floor to start drying from above and below and it will not have swollen to a significant degree. Cypress, a medium density...
softwood, and with its own unique properties has also been seen to be quite robust. Medium density hardwoods (such as Tasmanian Oak) and many softwoods (Pines) can be reasonably robust when fixed direct to joists, but being less dense and softer, some crushing at board edges can result in wider gapping at board edges when the floor dries. With top nailed floors, staining around nails is often minimal if the coating was in good condition at the time of the event or galvanised nails had been used, however this, or other discolouration also needs to be considered. If the flooring is secretly fixed, then adhesive will often have been used, but it is still necessary to ensure boards have remained tight to joists, and if not, top nailing of the floor may be an option. The two photos are of floors that are face nailed direct to joists and have recovered after more severe wetting. The first photo is of a Cypress floor that became flood inundated for about a 24 hour period. The second photo was taken some weeks after Cyclone Debbie and where water had ponded on this area of floor. In both cases there was limited moisture uptake, minimal expansion and both floors dried naturally to a flat even surface. In both cases the photos were taken prior to any remedial work had been undertaken.

The next subfloor system to consider is particleboard or plywood, on joists. If a floated floor has been laid, it is necessary to remove the affected flooring and underlay, with its integral or separate moisture vapour barrier. This will allow the subfloor to dry or be dried. With mechanical and adhesive fixed solid timber floors, over well-ventilated subfloor spaces, or perhaps ceiling removed beneath with a second level floor, good drying conditions occur or can be induced. For solid timber flooring drying through the upper exposed surface and the sheet subfloor from beneath. However it needs to be recognised that from the wetting of the floor moisture is trapped for a period between the upper surface of the sheet subfloor and lower surface of timber flooring. Boards will often cup within a few days of becoming water affected, as shown in the photo, and the longer that this remains before conditions conducive to drying are attained, the greater the negative effect on the floor. In addition to cupping, expansion with higher density flooring and crushing of board edges with lower density flooring can occur and the degree of expansion or crushing needs to be considered, as in both cases, wider gapping in the water affected area may result and can also be the reason for replacing the floor. However, in saying this we are aware of a number of floors that have either dried naturally or with accelerated drying and have been saved. In this instance solid timber floors are often secretly fixed and so aspects relating to fixing integrity also need to be considered. Regarding adhesive fixed engineered and bamboo floors, some have been repaired through allowing them to dry and then re-sanding and coating, but this depends on the product type and other damage or discolouration that may have occurred.

Attending to the conditions in the subfloor space is equally as important, as attending to the floor. Poor or inadequate ventilation and ground that permits ponding of water or maintaining wet conditions beneath the floor over a longer period, will be to the detriment of the floor, more often resulting in greater cupping and expansion of the floor.

Solid timber floors can be laid on plywood or battens over a concrete slab, or be direct adhesive fixed. Engineered and bamboo floors are either floated or directly adhesive fixed and laminate floors will be floated. When floors are floated, the same principal as outlined above applies, to remove the affected flooring and underlay with its integral or separate moisture vapour barrier.
Floors that are directly adhesive fixed to slabs are more difficult to save than floors on joists and there is greater conjecture around this topic. At times this relates to uncertainties regarding slab integrity, whether an applied moisture barrier was used and how well the floor has been or remains bonded to the slab. In addition to this views vary, as to how far moisture may have penetrated the slab and this also being affected by whether a moisture vapour barrier is present or not. Natural drying can take a very long time, boards are subject to moister conditions beneath for long periods and therefore cupping, expansion and crushing need to be considered and with solid timber flooring natural drying is more appropriate when only a small area of flooring is affected. Engineered floors can cup with raised board edges, crown with lower board edges or stay relatively flat and this reflects the many different constructions with engineered flooring. Again when affected areas are small, natural drying can be considered. Strand woven bamboo may develop a rippled surface as fibres swell or take on a darker discolouration and again, with density of the product and factory coating systems, it is difficult to dry from the exposed surface. Accelerated drying techniques have been used with solid timber flooring direct to slabs but often the drying needs to be more severe and over a longer period with higher density timbers. This can cause some damage to the flooring and moisture imbalances, necessitating recovery of the flooring before attempting sanding and coating. Even so, some floors have been recovered to the owner’s satisfaction and the photo shows a Blackbutt parquetry floor where a combination of drying processes and block replacement was undertaken.

At times there appears to have been a reluctance to lift a section of board prior to decisions being made to dry a floor. However, in many instances when larger areas are affected, this should be seen as part of the process in order to check or provide more information on the areas of uncertainty as outlined above (e.g. adhesive used, slab moisture, adhesive bond etc.), and this can also assist in monitoring the drying process.

When solid timber floors are laid on battens and the floor becomes wet, there is also conjecture over what is happening beneath the floor. Builder’s plastic is often laid over the slab and questions get asked about how much water may have travelled beneath the plastic and how wet the battens are. However, this method of installation, with a few boards lifted either side of the floor, does allow access to the subfloor and warm dry air can be circulated beneath the floor. Some floors have been saved by this method.

The most difficult floor to try to save is a higher density solid timber floor that has been fixed to plywood over a slab. Not only can there be uncertainties regarding the practices and products used beneath a floor, until a board is lifted for inspection, but the plywood, often pine based, will soak up the water that passes quickly through board joints. Higher density hardwood flooring will take up little moisture from a short event (e.g. a burst pipe), but when resting on ‘wet’ plywood the flooring will cup and expand with time. Accelerated drying in this instance needs to draw this wet reservoir of water in the plywood through the drier and slow to dry flooring above. Water can also track between the sheets of the plywood subfloor extending the area that may initially have been thought affected. Drying therefore is a very difficult task. In the adjacent photo the cupping is associated water that has tracked along the joints between plywood subfloor sheeting.

A final aspect to note with replacement floors over concrete subfloors is that slab moisture needs to be assessed and irrespective of whether there was a moisture vapour barrier present with the previous floor, such a barrier or reinstatement of the barrier is considered necessary with a replacement floor. The reason for this is that there have been residual slab moisture effects even when slab assessment at the time of laying has been considered acceptable. This is particularly so if driers have been used on slabs as part of the remedial work.
The decision as to repair or replace

The above has outlined some aspects that need to be considered when evaluating whether to attempt drying and repair of a floor that has become wet, and that this very much depends on both the flooring product and the subfloor. Another aspect to consider is the timing with some floors and floor systems more likely to return the floor back to near its pre-water event state much quicker than others. We have seen upper level solid hardwood floors on sheet subfloors, from a bath overflow, affecting part of a room being left for 6 to 12 months and the cupped floor dry to point that the boards have flattened and it being questioned as to whether any remedial work is necessary. We have also seen cupped solid hardwood floors on plywood over a slab that have been left for more than twelve months and little improvement in either the cupping or high moisture meter readings.

The decision as to whether to repair or replace is a complex decision with many factors to be considered. Some principals to be considered when making this decision are outlined below:-

• The type of flooring and cost to replace is important, so it is generally applicable to replace in part or full floated floors. Repairing a floor is more of a consideration with adhesive fixed floors and particularly when the floor has the added value of being unique, of special importance to an owner or difficult to match with replacement flooring.

• With adhesive fixed floors the extent of the water effects and damage to the floor from the water needs to be considered. Dark discoloration and effects of swelling or post drying shrinkage need due consideration. It also needs to be considered whether the flooring can be re-sanded and coated as part of the remedial work.

• With solid timber flooring, that often having the highest replacement cost, repair is more often considered. The density of the flooring species, the subfloor type and the method of installation over the subfloor will all affect the ease or difficulty and success of drying.

• It needs to be understood that replacing a section or even the whole floor is not without risks in terms of differences in the performance of the replaced floor to the original and owner acceptance of likes of colour and grade.

• If accelerated drying is used and not considered successful then full replacement has been necessary.

• Never sand a water affected cupped floor unless the moisture gradient (upper, middle and lower moisture meter readings) has been tested and considered acceptable. Floorboards with moisture gradients can crown if sanded prematurely. That is, and as shown in the photo, on sanding and coating the cupped floor is made flat, but moisture reduction in the lower part of the board over time, can result in board edges lowering known as crowning.

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