

# Specification and use of wood-based panels in exterior situations

Certain types of wood-based panels can be used in demanding exterior situations. However, they must be correctly specified, detailed, installed and maintained, in order to provide the desired performance and service life.

Exterior use covers a wide range of situations. They may be fully exposed to wetting by salt or fresh water or be more protected with a risk of occasional wetting, such as soffits under porches or lorry decks.

This Wood Information Sheet (WIS) is an overview of the subject with signposts to more detailed sources that are listed at the end. It includes BM TRADA's advice for specifying plywoods in exterior situations – see below '*Exterior*' plywood may still require treatment.

TRADA's *WIS 2/3-23: Introduction to wood-based panel products* [1] summarises the range of wood-based panels available in the UK.

The Wood Panel Industries Federation's *PanelGuide* [2] is a comprehensive guide to the use of wood-based panels in the UK.

TRADA's *WIS 2/3-17: Wood-based sheet materials for formwork linings* [3] deals with the use of wood-based panels for concrete formwork, a particularly onerous application.

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**Figure 1:** Woodstain finished plywood soffit lining at The Stonebridge Hillside Hub, West London

**Photo:** Cullinan Studio

## Key points

- Appropriate specification is the main consideration when using wood-based panels in exterior situations.
- When specifying a wood-based panel for exterior use, designers must consider two important concepts – service class and use class.
- The service class is determined by the relative humidity in the situation and hence the moisture content of the product.
- The suitability of a wood-based panel for use in a particular service class depends largely on the glue bond quality.
- The use class determines whether a preservative treatment or other protective measures are needed to achieve the desired service life.
- Wood-based panel products will perform differently to large sections of solid timber of the same species, and differently to each other, especially in an exterior environment.
- Wood-based panels are susceptible to moisture ingress through both faces and, in particular, via the panel edges.
- Except perhaps for short-life, non-construction uses or where the panel is made from modified timber or is preservative treated, a protective finish is generally necessary when using exterior grade wood-based panels in exterior situations to preserve their appearance. Certain panels are available with factory-applied finishes and these, and any modified or treated panels, should be used in accordance with the manufacturer's recommendations.

## Exterior exposure

When specifying a wood-based panel for exterior use, designers must consider two important concepts – service class and use class.

Like all wood products, the mechanical properties of wood-based panels vary with moisture content, which depends on the environment in which the panel is used.

Specifiers use service classes and use classes to determine the suitability and treatment of products for construction purposes, where failure of the product would not be acceptable in terms of aesthetics or safety.

The service class is determined by the relative humidity in the situation and hence the moisture content of the product. *BS EN 13986 Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking* [4] lists which product types are suitable for each service class. For example, a service class 2 application requires a panel suitable for humid conditions.

The use class then determines whether a preservative treatment or other protective measures are needed to achieve the desired service life. For example, an EN 636-3 plywood is suitable for service class 3 (exposure to wetting) but would probably require preservative treatment for use class 3 (exterior, out of ground contact), but not for use class 1 where it is often used.

The Wood Protection Association's *Manual: Industrial wood preservation specification and practice* [5] contains guidance on preservation treatments for wood-based panels.

### Service classes

Service classes are used in structural design to define the in-service environmental conditions and to specify appropriate modification factors to the design characteristic values. *Table 1* summarises the three service classes defined in *Eurocode 5* [6,7].

In some of the European (EN) panel product Standards, these three service classes are referred to as 'dry', 'humid' and 'exterior' conditions respectively.

Panels may be used in a higher service class service class than that appropriate to their type, but only where failure or degradation of the product would not be dangerous, or where a reduced service life is acceptable.

**Table 1:** Service classes and examples from Eurocode 5

Service class	Temperature	Approx RH*	EMC**	Examples from the UK National Annex to Eurocode 5 [7]
1	20°C	65%	12%	Warm roofs, intermediate floors, timber-frame walls – internal and party walls
2	20°C	85%	20%	Cold roofs, ground floors, timber-frame walls – exterior walls, exterior uses where member is protected from direct wetting
3	Conditions leading to higher moisture contents than service class 2		>20%	Exterior uses – fully exposed

\*RH Relative humidity: level not to be exceeded for more than a few weeks each year

\*\*EMC Maximum equilibrium moisture content for most softwoods. In similar conditions the EMC of panel products will typically be lower

### Use classes

Use classes are used when specifying materials at risk of biological attack by fungi or invertebrates. *Table 2* summarises the use classes defined in *BS EN 335 Durability of wood and wood-based products. Use classes: definitions, application to solid wood and wood-based products* [8].

### Factors affecting performance

The factors of exterior exposure that can have a significant effect on the performance of wood-based panels include:

- rainfall (particularly wind-driven) and soil water where the panel is in contact with the ground
- the ease with which drying out is possible
- fluctuations in relative humidity and temperature
- moisture content arising from the above environmental factors
- sunlight, particularly on south-facing aspects and for dark coloured surfaces
- fungal organisms and insect attack
- frost and freeze-thaw action
- chemical pollution, such as salt.

Correct design, detailing, workmanship and maintenance can help to minimise the impact of some of these factors. Wood-based panel products, because of their nature, will perform differently to large sections of solid timber of the same species, and differently to each other, especially in an exterior environment.

Table 2: Use classes and indicative risks

Use class	Situation	Risk to wood-based panels		
		Moisture content	Mould and fungal attack	Insect (and/or other invertebrate) attack
1	Under cover, fully protected from weather and not exposed to wetting	No higher than that resulting from exposure to a temperature of 20°C and RH of 65%	Regarded as being dry, and thus the risk of attack by surface moulds or by staining or wood-destroying fungi is insignificant	For plywoods, attack is possible, its frequency and importance depends upon the geographical region. Attack by beetles can also depend upon veneer species and thickness. For all other panel products, no risk of attack except by termites
2	Under cover and fully protected from the weather but where high environmental humidity can lead to occasional but not persistent wetting	Can occasionally attain or exceed that which would result from exposure to a temperature of 20°C and RH of 90%	Moisture content can occasionally increase to a level which can allow growth of wood-destroying fungi. Disfigurement of decorative panels can also occur as a result of surface moulds and staining fungi	
3**	Not covered and not in contact with the ground. Either continually exposed to the weather or protected from the weather but subject to frequent wetting	Frequently above 20%	Often liable to attack by wood-destroying fungi. Disfigurement of decorative panels can also occur as a result of surface moulds and staining fungi. The use of particleboards* and fibreboards is appropriate only if the inherent and/or conferred properties of the board are adequate	
4	In contact with the ground or fresh water and thus permanently exposed to wetting	Permanently above 20%	Liable to attack by wood-destroying fungi. Use of plywoods only appropriate if the inherent and/or conferred board properties are adequate. This often involves treatment with a chemical preservative. Current EN product standards do not include grades of particleboard, oriented strand board (OSB) or fibreboard that are suitable for use in this class, but there are panels with enhanced performance that may be suitable for use in this class, when used in accordance with the manufacturer's guidance.	
5	Permanently exposed to salt water	Permanently above 20% and wholly or partially submerged in salt water	Liable to attack by wood-destroying fungi. Use of plywoods only appropriate if the inherent and/or conferred board properties are adequate. This often involves treatment with a chemical preservative. No particleboards*, OSB or fibreboards are currently manufactured for use in this use class	

\* Because of the cement, the risk of attack of cement-bonded particleboard by wood-destroying organisms is insignificant in all use classes

\*\* BS EN 335 allows for the subdivision of Use Class 3 into Classes 3.1 and 3.2 based on the duration of wetting that is likely

## Moisture

TRADA's WIS 4-14: *Moisture in timber* [9] describes the effect that moisture has on wood, a particular problem for wood in exterior situations.

Wood-based panels are susceptible to moisture ingress through both faces and, in particular, via the panel edges. Direct wetting or an increase in the local humidity can result in an increase in moisture content and lead to swelling of the panel. Therefore, it is imperative that all edges of all panels be protected in order to achieve satisfactory performance.

The edges of fibreboards, particleboards and OSB are more coarse textured than the faces and are susceptible to moisture ingress. In plywood, exposed end grain and/or wood fibres at the edges facilitate moisture ingress. The presence of core gaps or veneer overlaps can create localised areas of ridging on plywood faces as a result of changes in moisture content.

Moisture ingress can cause swelling and unsightly staining behind a translucent/clear finish. Fungal decay may lead to severe degradation of wood-based panels if they remain wet in service

for prolonged periods. Adequate ventilation can help to reduce the effects of wetting. Coatings or other protective design measures can help reduce the rate of moisture change.

Water will penetrate into wood-based panels much more rapidly than it is lost by drying to air under normal conditions. This is particularly the case if its entry is localised, such as through an area of improperly applied edge sealant or large exposed core gap in plywood. Under these conditions, water can be trapped for long periods behind fairly impermeable finishes, putting considerable demands on the adhesion between the wood substrate and the surface coating or finish. Continuous fluctuations in relative humidity can also be problematic and cause dimensional changes to wood-based panels, particularly fibreboards, particleboards and OSB that are more susceptible to swelling in thickness. Panels that have swelled usually recover partially when dried. However, some swelling is usually irreversible.

Repeated wetting and drying of unfinished plywood panels can result in lathe checks opening up on the face veneer surface. Similarly, the surface strands/flakes of wood used to produce OSB panels can degrade and peel off, if left permanently exposed to the elements and without an appropriate coating.

### Sunlight

Exposure to direct sunlight can cause a rapid change of colour of unprotected wood-based panels. Prolonged exposure will lead to general lightening/greying of the wood surface. A rough, bleached, weathered appearance may be acceptable; otherwise, specify a protective finish.

### Checklist for specifiers

Correct specification should cover the properties required of the basic material as well as treatments, finishes, fixing details and structural properties. It is worth considering each property although not all items will be appropriate to every situation and others may also be involved, for example, specific structural applications. See also TRADA's *WIS 2/3-57 Specifying wood-based panels for structural use* [10].

Check these factors when specifying wood-based panels in exterior situations:

- service class and use class suitability with respect to the type and grade of panel to be used
- whether a load-bearing panel is required
- intended service life
- aspect and prevailing weather conditions
- thickness
- veneer thickness and lay-up (plywood only)
- desired aesthetic qualities
- species durability (plywood only)
- preservative treatment requirements
- edge sealing treatment
- finish type (such as paint and stain)
- moisture content at time of installation compared to that in service (shrinkage /contraction)
- sanding or preparation requirements before finishing
- maintenance requirements
- type and suitability of fixings
- ease of replacement.

### Suitability of wood-based panels for use in service classes 2 and 3

The suitability of a wood-based panel for use in a particular service class depends largely on the glue bond quality and its ability to withstand certain in-service conditions for prolonged periods of time. *Table 3* summarises the requirements for use in a service class 2 or 3 environment, for each wood-based panel product Standard. A panel suitable for service class 3 can also be used in service classes 1 and 2.

### Load-bearing applications

For applications involving panels in service class 3, *Eurocode 5* gives design factors for plywood only. Cement-bonded particleboard could probably be used, but *Eurocode 5* offers no design factors. The other service class 3 boards shown in *Table 3* are unsuitable for load-bearing applications.

### Durability of wood species for wood-based panels

The methods for testing the durability of solid wood and wood-based products, including panel products, are given in *BS EN 350 Durability of wood and wood-based products. Testing and classification of the durability to biological agents of wood and wood-based materials* [20]. *BS EN 350* also lists the natural durability of many commercially available species of wood.

In addition to classifications for common species and a method for assigning solid wood species to a durability class by laboratory testing, this also allows for testing of wood-based panels for assignment to a durability class. These can include panels that are treated or modified in some way to enhance their durability.

**Table 3:** Service classes and examples from Eurocode 5

Panel type	Product Standard	Service class 2	Service class 3
Plywood	BS EN 636 Plywood. Specifications [11]	EN 636-2	EN 636-3
Oriented strand board (OSB)	BS EN 300 Oriented strand boards (OSB). Definitions, classification and specifications [12]	OSB/3 OSB/4	–
Medium density fibreboard (MDF)	BS EN 622-5 Fibreboards. Specifications. Requirements for dry process boards (MDF) [13]	MDF.H MDF.HLS* L.MDF.H MDF.RWH***	Exterior MDF (products are commercially available but not defined in a BS or EN product Standard)
Hardboard	BS EN 622-2 Fibreboards. Specifications. Requirements for hardboards [14]	HB.H HB.HLA1 HB.HLA2	HB.E **
Mediumboard	BS EN 622-3 Fibreboards. Specifications. Requirements for medium boards [15]	MBL.H MBH.HLS1* MBH.HLS2*	MBL.E **
Softboard	BS EN 622-4 Fibreboards. Specifications. Requirements for softboards [16]	SB.H SB.HLS*	SB.E **
Particleboard (also known in the UK as chipboard):	BS EN 312 Particleboards. Specifications [17]	P3 P5 P7	–
Cement-bonded particleboard	BS EN 634-1 Cement-bonded particle boards. Specification. General requirements [18] and BS EN 634-2 Cement-bonded particleboards. Specifications. Requirements for OPC bonded particleboards for use in dry, humid and external conditions [19]	Class 1 Class 2	Class 1 Class 2

\* Restricted to instantaneous or short term load duration

\*\* Should only be used in exterior situations if a treatment of proven exterior durability (coating or otherwise) has been applied to relevant surfaces and edges

\*\*\* MDF.RWH - may also be used as a rigid underlay in roofing and walls where it is subject to instantaneous (e.g. wind) or short-term (e.g. snow) load duration only

– No suitable products defined

BS EN 460 Durability of wood and wood-based products. Natural durability of solid wood. Guide to the durability requirements for wood to be used in hazard classes [21] contains guidelines for the durability requirements for each hazard class (now known as use classes).

In basic terms, consider the natural durability of each wood species used in a wood-based panel and then specify treatment or coatings if required, depending on the appropriate use class. Table 4 shows that the majority of particle-based or fibre-based panel products are not suitable for use in situations requiring use class 3 and above, with the exceptions of exterior grades and cement-bonded particleboard. Consideration of species durability is therefore most relevant to plywood.

An exterior bonded plywood is probably the most commonly used panel for exterior construction applications. Due to the almost infinite number of wood species combinations possible, take extra care when specifying plywood for situations where biological attack may occur.

The fact that a particular brand of plywood employs class 2 or 3 glue bonds to BS EN 314-2 Plywood. Bonding quality. Requirements [22] in its manufacture does not automatically imply that it is suitable for long-term exterior exposure in its 'as-received', natural state. If there is a risk of prolonged wetting and an extended service life is required, then specify that the wood component of plywood be sufficiently durable (resistant to fungal or insect attack) as well as adequately bonded. For satisfactory long-term service, most exterior uses demand either a durable



veneer species, preservative treatment or an appropriate factory applied coating/finish. *DD CEN/TS 1099 Plywood. Biological durability. Guidance for the assessment of plywood for use in different use classes* [23] contains guidance.

Plywood can be pressure impregnated with wood preservatives. Consult preservative manufacturers or treatment companies to identify suitable treatment for a specific use. Insect attack of plywood in service is infrequent in exterior situations in the UK and is not considered further here. Having identified which use class is appropriate, consult *BS EN 350* to determine whether the species of timber used has adequate inherent decay resistance (natural durability). If not, determine what level of preservative treatment/factory-applied protective coating/finish would be appropriate, but note that sapwood of all species is rated as not durable. *DD CEN/TS 1099* contains guidance on which durability classes for the veneers used in a plywood under certain use classes require treatment.

The 2016 version of *BS EN 350* allows for the laboratory testing of wood-based materials, for example wood-based panels, to directly assign them to a durability class. This approach can also be applied to preservative-treated wood-based panels, or those made from modified wood. Field testing is also possible in accordance with Annex F of *BS EN 350*.

In practice, with good design, installation and maintenance, decay in plywood used in exterior situations is relatively uncommon, despite the fact that it may well contain sapwood.

Marine grade plywood, manufactured and marked in accordance with *BS 1088-1:2003. Marine plywood. Requirements* [24], can be manufactured from inherently durable timber species, although other non-durable species, such as gaboony, can also be used if correctly marked. Even if a marine plywood is made from a durable species, constant wetting and drying and exposure to the elements can lead to surface checking and roughness. The timber will also weather to a grey colour unless a coating or finish is applied. If *BS 1088* plywood is used in construction it must also comply with *BS EN 13986*.

The final choice, however, must be based on individual assessment of the exposure condition, maintenance schedule, risk of failure in service and intended service life. TRADA's *WIS 4-28: Durability by design* [25] contains guidance on life and risk assessment.

### **Biological durability of wood-based panel products**

Service class 2 stipulates very similar in-service conditions to use class 2. However service class 3 is characterised by material

moisture contents higher than that of service class 2 which requires use classes 3, 4 and 5 to be considered. As shown in *Table 2*, wood-based panel products used in use classes 2 to 5 are likely to be subject to biological attack. For construction purposes some wood-based panel product types may be suitable in these situations and others may not. *Table 4* shows the suitability of different types of panel products with respect to their biological durability in use classes 2 to 5. The guidance for plywood is taken from *DD CEN/TS 1099*.

### **'Exterior' plywood may still require treatment**

There is some confusion among specifiers concerning the properties of 'exterior grade' plywood. Most confusion arises from a misinterpretation of *BS EN 636*, which classifies plywood for use in dry conditions (EN 636-1), humid conditions (EN 636-2) and exterior conditions (EN 636-3). This classification is based on use class and suitability is largely determined by the glue bond between veneers. There are no specific requirements in the Standard relating to resistance to biological attack (insects or fungi). However, the potential risk of attack is outlined in Use Class 3 of *BS EN 335*.

BM TRADA recommends that specifiers take the following approach.

Essentially, there are four variables that can be specified:

- glue bond class
- durability of the plies
- presence of sapwood
- protective treatments.

### **Glue bond**

To ensure an adequate glue bond it is sufficient to specify the appropriate plywood class from *BS EN 636*. The method used to assess glue bond quality is similar to the older weather proof and boil (WBP) test that is still commonly referred to in the construction industry, although this term is no longer used in the current British (European) Standard.

However, 'exterior conditions' corresponds to exterior weathering which can be expected to include periods of persistent wetting. Some specifiers wrongly assume that plywood specified or labelled as 'EN 636-3' is suitable for exterior use without any further protection, whereas EN 636 refers mainly to the quality of the glue bonds. An EN 636-3 classification indicates that the glue bonds are likely to perform satisfactorily if exposed to long-term wetting.

Table 4: Wood-based panels suitable for use classes 2 – 5

Wood-based panel type	Use class 2	Use class 3	Use class 4	Use class 5
<b>Plywood</b>				
Plywood species durability class 1	U	U	U	U
Plywood species durability class 2	U	U	UT	UT
Plywood species durability class 3	U	UT	TU	TU
Plywood species durability class 4	UT	TU	T	T
Plywood species durability class 5	UT	TU	T	T
<b>OSB</b>				
OSB/3	UT#	–	–	–
OSB/4	UT#	–	–	–
<b>MDF</b>				
MDF.H	UT#	–	–	–
MDF.HLS*	UT#	–	–	–
Exterior MDF ##	UT#	TU#	–	–
<b>Hardboard</b>				
HB.H	UT#	–	–	–
HB.HLA1	UT#	–	–	–
HB.E	UT#	TU#	–	–
HB.HLA2	UT#	–	–	–
<b>Mediumboard</b>				
MBL.H	UT#	–	–	–
MBH.HLS1*	UT#	–	–	–
MBH.HLS2*	UT#	–	–	–
MBL.E	UT#	TU#	–	–
<b>Softboard</b>				
SB.H	UT#	–	–	–
SB.HLS	UT#	–	–	–
SB.E	UT#	TU#	–	–
<b>Particleboard</b>				
P3	UT#	–	–	–
P5	UT#	–	–	–
P7	UT#	–	–	–
Cement Bonded Particleboard Class 1	U	U	U	U
Cement Bonded Particleboard Class 2	U	U	U	U
<p>U untreated            UT left untreated is normally sufficient but, under certain end uses, treatment can be advisable            TU treatment is normally advisable but, in certain end uses, the panel may be left untreated            T treatment necessary            # For particleboards and fibreboards treatment is often difficult or impossible, therefore a properly maintained coating may be the only way to achieve the desired result            ## Although commercially available, Exterior MDF is not defined in a BS or EN product standard            – unsuitable</p>				

## Durability, sapwood and protective treatments

*BS EN 636* states that (for exterior use): '...the performance of most plywood will be compromised if suitable preservative treatment and/or relevant surface and edges coating is not applied and if the panels are not properly maintained and installed'. However, it does not include a specific minimum durability against decay for the wood used in the manufacture of plywood. Since sapwood cannot usually be easily excluded, BM TRADA considers that, in most cases, all plies should be assumed to be 'not durable' (that is, durability class 5 according to *BS EN 350*).

For guidance on durability both *BS EN 636* and *Eurocode 5* refer to *BS EN 335* and *DD CEN/TS 1099*. These Standards advise taking account of factors such as the natural durability of the species, the degree of exposure, protection and maintenance, ease of replacement and desired service life. Since the plywood manufacturer is unlikely to be aware of the eventual end use, the onus rests on the specifier to consider these factors and determine whether or not the product has sufficient durability for a specific application. In most cases an exterior grade plywood will need preservative treatment or other protective measures if it is to have an acceptable service life in a use class 3, 4 or 5 situation.

## Service classes 1 or 2/use classes 1 or 2

Most of the exterior grade plywood used in construction is in situations that are generally dry with only occasional wetting during the construction process or in service, for example most internal flooring, wall and roof sheathing applications. These are service class 1 or 2/use class 1 or 2 situations for which an EN 636-1 or EN 636-2 plywood would be appropriate but in many cases an EN 636-3 plywood will be used. For such applications wood durability is of less importance. Plywoods using wood veneers classified as 'not durable' have been used satisfactorily in these situations for more than 50 years in the UK.

## Service class 3/use classes 3, 4 or 5

The factors to consider when deciding whether to specify preservation include the severity of the use class, the desired service life and the consequences of deterioration.

It can be very difficult to determine the constituent species of many types of plywood, particularly of tropical origin and, in any case, no plywood specification totally excludes sapwood, which is always rated in the lowest durability class. A plywood manufacturer is not required to provide the durability class or species of the wood used to manufacture plies as part of the CE mark, although it may be given in the description or the accompanying documents. This makes it difficult for the specifier to assess the need for treatment.

In contrast, BM TRADA Certification's Q-Mark scheme for plywood addresses this issue by making it mandatory to declare the wood species and durability in the panel label. Where the Q-Mark indicates that the wood used is 'not durable' (that is, durability class 5) then this will normally require treatment where the wood is exposed to use class 3, 4 or 5 situations.

## Finishes

Except perhaps for short-life non-construction uses, such as site hoarding or boarding-up purposes, a protective finish is generally necessary to preserve the appearance of exterior grade wood-based panels in exterior situations. TRADA's *WIS 2/3-1: Finishes for external timber* [26] offers guidance.

For most applications, wood-based panel manufacturers recommend that any exterior grade panel used in exterior situations should be fully coated prior to installation. This includes both faces and all edges, including those cut on site. This will help to minimise moisture ingress and provide more balance to the panels, for example to prevent thinner panels, such as those used for soffits, warping in service. There are several types of paint finish available and specifiers should seek guidance from the paint/coating manufacturer on their suitability and use for the particular wood-based panel type and use class, their methods of application and maintenance cycles.

For plywood use a good face grade. *DD CEN/TS 635-4 Plywood. Classification by surface appearance. Parameters of ability for finishing, guideline* [27] contains guidance on which surface grades are suitable for coating under each service class. For example, a surface grade 1 plywood that is sanded or textured, with a face veneer thickness of 0.4mm to 3mm and inner plies of a maximum thickness of 5mm with no open defects on the first inner ply, can be painted for use in service class 2 conditions.

As OSB is produced from individual flakes or strands, a completely smooth finish is more difficult to achieve than with other panel types. MDF exterior grade generally requires a surface coating to be applied; see manufacturer's guidance. Make sure that edges have taken up enough coating to be an effective barrier to moisture. For hardboards, mediumboards and softboards, coating may not be suitable due to the uptake of moisture causing movement. Additives, such as oil, present in the panel may also affect choice of coating.

On all panels intended for exterior use take care with the surface preparation and the application of finishes. For example, MDF (which can be finely machined) must have all the edges



rounded if a satisfactory paint finish is to be achieved. Regular maintenance will help prolong the service life of wood-based panels when used in exterior applications. Follow the manufacturer's guidance in this respect.

Use low-build exterior wood stains with plywoods only, as they are not suitable for other panel types. Stains possess certain advantages over film-forming finishes by being more able to cope with the movement of exposed plywood. Exterior wood stains will not flake off in response to checking of the veneer as a result of wood movement. If surface checking occurs, redecoration with a pigmented product will protect the checked surface and should present an acceptable appearance. Patches, inserts, filler and overlaps on plywood face veneers will show up with a light coloured stain finish.

Some plywood/exterior finish combinations in use class 2 situations, such as soffits or under eaves, can cause salts to migrate and appear on the surface of the coating. Light colours are less vulnerable to this effect.

### Factory-applied finishes/modifications

There is now a range of panel products with factory-applied coatings, some of which provide a degree of protection from wetting, either short or long term. The manufacturer's guidance should be followed in relation to installation, protection and degree of exposure, as there are no specific requirements for coatings given in the relevant BS ENs.

Plywoods are available overlaid with specialist slip-resistant coatings that are used in applications such as lorry decking, scaffold platforms, ramps and mezzanine floors. These types of plywood do not require further surface preparation or finishing, but resealing of cut edges and drilled holes is essential if a prolonged service life is to be achieved. Other speciality plywoods are available with a resin-impregnated paper overlay for painting. The impregnated paper substrate provides a smooth defect-free surface, ideal for painting. Some end uses for this product are signboards, fascia panels, playground equipment, formwork for concrete and vehicle building.

Certain types of OSB are available with a factory-applied, exterior, impregnated paper overlay, or painted surfaces. These can be used for applications such as site hoarding, where the coating is intended to extend the service life of the panel.

Particleboard flooring is also available with a waterproof coating, which is intended to provide protection from temporary wetting

during construction. Particleboard is not intended for long-term exterior use.

MDF made with chemically modified fibres is also available. These products can have improved stability and durability for use in exterior conditions, but should be used in accordance with manufacturer's guidance.

Another advantage of many overlaid panel types is that factory sealing of edges is standard and specialist edge sealing is also available on request from many mills. Reseal cut edges and drilled holes prior to installation.

### Design and workmanship

When correctly specified and utilised, wood-based panels are robust materials. Much depends on the actual conditions, but it is possible to state some general rules applicable to all but very temporary exterior use of wood-based panels.

Edges of panels must be sealed to minimise absorption of water. Such sealing may be with:

- special sealing compounds, such as 2-part epoxy
- non-setting mastics if the panel is set in frames
- polyurethane, acrylic or rubber-based paints
- wooden beading bonded with exterior adhesives
- metal or plastic capping or channels fixed with non-setting mastic
- two or three coats of paint applied to all edges.

'Special' edge sealing is also available from some plywood manufacturers on request.

Good design and site workmanship are essential in all cases. In addition to edge sealing, the top and bottom edges of panels should be chamfered, bevelled or rounded to promote shedding of water and to maintain good paint adhesion. Consider designs that incorporate a measure of protection to wood-based panels as this can prolong the service life of panels when subject to exterior conditions. For example, consider large eaves overhang to prevent driving rain from hitting panels; slopes or gradients to decks in order to shed water; and designs that allow for the free flow of air around panels to promote drying. Detailing and design must ensure that water is shed effectively and does not soak into the backs of panels, especially in areas such as soffits where cavities must be adequately ventilated to allow dispersal of moisture.

Failure to leave expansion gaps around the edges of panels can lead to buckling (3mm gap on each edge is generally considered adequate).

Provide clearance at panel joints for water to drain freely. Mastic joints between panels are unlikely to be satisfactory due to the cumulative movement across the width or length of the panel being concentrated in the area of the joint. Exposed or concealed joints may be used but should, in each case, provide a gap for expansion and drainage. The gap should be wide enough to facilitate re-treatment of the panel edges when redecorating.

Similar considerations apply when detailing the junctions between wood-based panels and masonry. Leave adequate clearance at the junction to allow for panel expansion, drainage and prevention of capillary absorption of water from the porous masonry, and to allow periodic reinforcement of the edge sealing. The bottom edges of the panels should stand well clear of any flashings or sills for similar reasons.

Specify non-concealed fixings that are non-ferrous, or of a suitable grade of stainless steel, in order to prevent unsightly iron-staining. Pay particular attention to this when using translucent finishes, since any staining due to moisture or corrosion products is readily visible against a relatively uniform background.

## Maintenance

Appropriate specification is the main consideration when using wood-based panels in exterior applications. Maintenance is then restricted to the renewal of surface coatings, the repair of edge sealing, the replacement of sealants and possibly remedial action on fixings.

Follow manufacturer's maintenance intervals for coatings and methods for re-coating for these product types. The maintenance interval will also depend on the level of exposure and elevation. For example, wear and erosion of the coating is more apparent on south- and west-facing elevations. As for solid wood, where coating failure leads to weathering of the wood/wood particles, then successful recoating will require the surface of the panel to be sanded to provide a suitable key for coating adhesion. For that reason it is essential that recommended maintenance intervals be observed.

Panels with factory-applied, phenolic-resin film or GRP type coatings can also be repaired with patching compounds and many panel manufacturers provide data sheets for these procedures.

## Construction Product Regulation

Under the Construction Product Regulation (CPR), which came into effect in 2013, the panel manufacturer is required to comply with the requirements of *BS EN 13986* and to CE mark accordingly where a panel product falls within the scope of *BS EN 13986* and is intended for use in construction. The manufacturer must produce a Declaration of Performance for the product, stating the performance claimed in respect of various properties and the whole supply chain has a responsibility to ensure that this information is made available to whoever needs it.

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### About TRADA

The Timber Research and Development Association (TRADA) is an internationally recognised centre of excellence on the specification and use of timber and wood products.

TRADA is a company limited by guarantee and not-for-profit membership-based organisation. TRADA's origins go back over 80 years and its name is synonymous with independence and authority. Its position in the industry is unique with a diverse membership encompassing companies and individuals from around the world and across the entire wood supply chain, from producers, merchants and manufacturers, to architects, engineers and end users.

### Our aim

To provide members with the highest quality information on timber and wood products to enable them to maximise the benefits that timber can provide.

### What we do

We seek to achieve this aim through active and on-going programmes of information and research. Information is provided through our website, an extensive collection of printed materials and our training courses.

Research is largely driven by the desire to update and improve our information so that it continues to meet our members' needs in the future.

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