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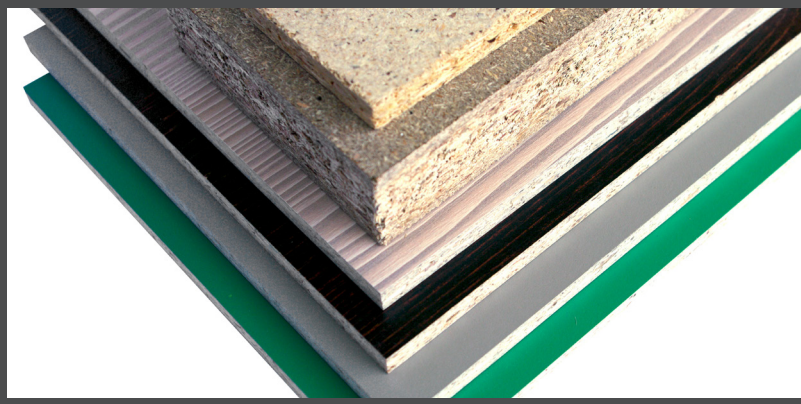
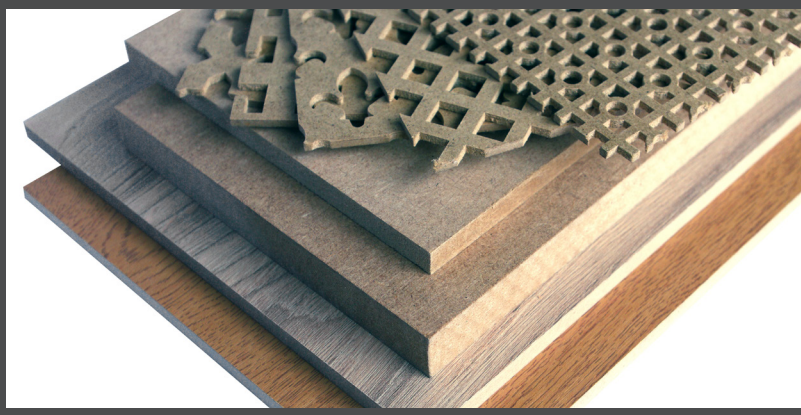
Panel Guide

Version 4







Annex 2C: Cement bonded particleboard (CBPB)

Description

Cement-bonded particleboard (CBPB) was first commercially manufactured in the early 1970s and has continued to be manufactured in relatively small quantities, satisfying the requirements of specialised end-use applications. There are perhaps only about 50 of these mills worldwide, each producing on average only about 200 m^3/day.

The panel is a mixture of wood particles and Portland cement together with some additives. The first impression of the panel is that it is grey in colour, has a smooth almost polished surface and is heavy. This initial assessment of the panel fails to appreciate its outstanding merits especially in terms of reaction to fire, durability, stability, sound insulation and stiffness.

Figure A2.3: Cement-bonded particleboard

Composition

Following storage for at least 3 months, the debarked softwood logs of selected species are reduced to flakes some 10mm to 30mm in length and 0.2mm to 0.3mm in thickness using drum-knife flaking machines. After passing through a hammermill, the flakes are separated into surface and core material by screening, and are then mixed with Portland cement and water in the ratio by weight of:

- cement 60%
- wood 20%
- water 20%.

Small quantities of chemicals are added to the wet mix; one of their purposes is to accelerate cement setting.

The mat is formed in three layers, the outer layers comprising small chips. Unlike normal particleboard production in a multi-daylight press, the set of cauls in CBPB production must be kept under pressure until the cement has set. This is achieved by fixing a set of clamps to each set of cauls while in the press; these clamps are then released some 6 to 8 hours later after the set of cauls has passed through a heated chamber at 70°C to 80°C. The panels are further dried before shipment.

It is the high mass of Portland cement which confers on the product its:

- good reaction to fire behaviour
- very high durability (as a result of the panel having a pH of 11)
- high stiffness (E = 4500 N/mm^2)
- very good sound insulation
- good dimensional stability relative to other wood-based composites.

Appearance

CBPB is readily identified from its mid-grey somewhat polished appearance. The surface is very smooth, cementitious and devoid of wood chips; however, when heavily sanded the surface can appear very similar to that of resin-bonded particleboard. In cross-section the chips, particularly in the middle layer of the panel, can be clearly seen: there are very few holes to be seen with the cement encasing the wood chips.

Density mass and panel size

Panel density is a function of the percentage volume of cement used, together with the degree of pressure exerted on the mat. Most manufacturers produce a panel with a minimum density of 1100 kg/m^3. This means that a 2400mm × 1200mm × 12mm panel will weigh approximately 45kg. This can give rise to handling problems, especially with thicker panels.

Panel sizes commonly available are 1200mm × 2440mm and 1200mm × 3050mm in thicknesses of 6mm to 40mm. Square-edged panels are the standard; profiling is done to order.

Applications

Primarily because of its lay-up, composition and mass, CBPB is mainly used for specialised applications in construction. Its outstanding merits (especially in terms of reaction to fire, durability, sound insulation and stiffness) render the product most suitable for internal wall construction in public places, lining of lift shafts, construction of cabling ducts, soffits, motorway acoustic fencing and cladding of prefabricated house units.

Specification

CBPB manufactured in Europe must now be specified in accordance with *BS EN 634-1 Cement-bonded particle boards. Specification. General requirements*[1]. As explained in PanelGuide *Section 2*, CBPB that is used in construction must comply (by law) with the Construction Products Regulation (CPR) by compliance with *BS EN 13986*; this standard calls up *BS EN 634* which is in two parts:

- *BS EN 634-1 Cement-bonded particle boards. Specification. General requirements*
- *BS EN 634-2 Cement-bonded particleboards. Specification. Requirements for OPC bonded particleboards for use in dry, humid and exterior conditions*[2]

Guidance on the selection of CBPB is given in tabular format in PanelGuide *Sections 2.4 to 2.14*.

Physical properties

Climate

Like other wood-based panel products, CBPB is hygroscopic and its dimensions change in response to a change in humidity; in terms of thickness, the extent of dimensional change is only about 5% that of wood-based panels bonded with an organic adhesive. A 1% change in moisture content typically increases or decreases the length, width and thickness of CBPB by the amounts set out in *Table A2.14*.

Table A2.14: Dimensional change of CBPB for a 1% change in panel moisture content (DD CEN/TS 12872)

Specification	Dimensional change at 1% change in panel moisture content		
	Length %	Width %	Thickness %
BS EN 634	0.05	0.05	0.04

As a guide, CBPB can be expected to attain the moisture content under specified conditions in *Table A2.15*.

Table A2.15: Expected moisture content of CBPB

Relative humidity at 20°C	Approximate equilibrium moisture content
30%	5%
65%	10%
85%	14%

Like other wood-based panels, CBPB must be conditioned to bring it into equilibrium with its environment before it is fixed (*Table A2.16*). This is usually achieved by loose stacking the panels in the room where they will be used prior to fixing them. The time required for the panels to achieve equilibrium moisture content will vary depending upon the temperature and relative humidity in the building. It is difficult to achieve an exact equilibrium moisture content with CBPB as, like concrete, it continues to gain weight (and strength) with time, but at an ever-reducing rate, due to carbonation.

Table A2.16: Likely equilibrium moisture content of CBPB in various conditions

In a building with continuous central heating	5% to 7%
In a building with intermittent central heating	8% to 10%
In an unheated building	up to 15%

Biological attack

CBPB because of its high alkalinity (pH 11) will not normally be attacked either by wood-boring insects common in temperate or tropical climates or by fungi even at high moisture contents.

Water vapour 'permeability'

The value of the water vapour resistance factor (μ) for CBPB varies with the method of determination (*BS EN ISO 12572*) as set out in *Table A2.17* which is an extract from *BS EN 12524* and *BS EN 13986*.

Table A2.17: Water vapour resistance factor (μ) for CBPB

Mean density	Vapour resistance factor	
Kg/m^3	Wet cup μ	Dry cup μ
1200	30	50

Thermal conductivity

The thermal conductivity (λ) of CBPB as determined according to *BS EN 12664* is 0.23 W/m.K for a mean density of 1200 kg/m^3 as set out in *BS EN 13986*.

Reaction to fire

Under the Euroclass system for characterising the reaction to fire performance of materials, as taken from *European Commission Decision 2007/348/EC*, an untreated CBPB may be assumed to achieve the performance in *Table A2.18*.

If the manufactured product does not satisfy any of these minimum requirements and a reaction to fire claim is to be made in a DoP for CE marking purposes, then it must be tested and classified according to *BS EN 13501-1*. However if no claim is made in the DoP for CE marking purposes it is still possible to use the British standard system to make a separate claim.

Further information on the reaction to fire testing in both the BS and EN systems is provided in PanelGuide *Section 2.2.3*.

Table A2.18: Reaction to fire classification without further testing of untreated CBPB

Product	EN Product standard	End use condition[2]	Minimum density (kg/m^3)	Minimum thickness (mm)	Class [3] (excluding floorings)	Class [4] (floorings)
Cement-bonded particleboard[4]	BS EN 634-2	Without an air gap behind the panel	1000	10	B-S1, d0	B_{fl}-s1

[1] Mounted without an air gap directly against class A1 or A2-s1, d0 products with minimum density 10kg/m^3 or at least class D-s2, d2 products with minimum density 400 kg/m^3

[2] A vapour barrier with a thickness up to 0,4mm and a mass up to 200 g/m^2 can be mounted in between the wood-based panel and a substrate if there are no air gaps in between

[3] Class as provided for in Table 1 of the Annex to Decision 2000/147/EC

[4] Class as provided for in Table 2 of the Annex to Decision 2000/147/EC

NOTE: The classes given in this table are for unjointed panels, T&G jointed panels installed according to *DD CEN/TS 12872* and fully supported joints installed according to *DD CEN/TS 12872*

Storage and handling

Careful storage and handling is important to maintain panels in their correct condition for use; therefore CBPB must be protected from rain and accidental soaking. During transport, it is particularly important to keep edges well covered. Panels should be stored flat in an enclosed, dry building. When handling panels, the edges and corners should be protected against damage and care should be exercised in the carriage of thin panels.

Detailed guidance on the storage and handling of wood-based panel materials is given in *DD CEN/TS 12872* and PanelGuide *Section 4*.

Working with CBPB

CBPB should be cut by power saw and machined (routed, spindled, planed and bored) with normal woodworking machinery fitted with tungsten carbide cutting edges. Dust extraction equipment must be employed in enclosed spaces.

Further information on working with CBPB is included in PanelGuide *Section 4.4*.

Mechanical joints and fixings

Wherever possible, fittings that depend upon face fixing should be selected; fittings that depend upon the expansion of a component inserted into the panel edge should be avoided.

Conventional woodworking fixings and techniques can be applied to CBPB which provides good holding power for screw fixings into the panel faces. Edge screwing is possible; in panels greater than 16mm in thickness, pre-drilled holes are required. Countersunk parallel core screws should be used in both edge and face fixings because they have greater holding power than conventional wood screws. A high ratio of overall diameter to core diameter is desirable. Because of the high alkalinity of the panel, stainless steel or galvanised screws with a diameter up to 4.2mm should be used.

Drill pilot holes for all screw fixings. Typically, the holes should be 85% to 90% of the screw core diameter. Fixings into the panel face should not be within 15mm of edges of panels up to 16mm in thickness (20mm for panels up to 22mm in thickness) and within 40mm of the corners.

Manual nailing of serrated or twisted nails up to 3.1mm in diameter is possible in panels up to 12mm in thickness. Above 12mm, either pre-drilled manual insertion or non-pre-drilled pneumatic fixing should be used. Nails must be flat-headed and galvanised, sheradised or of stainless steel.

Panels can also be fitted together using galvanised or stainless steel clips.

Further information on fixing CBPB is included in PanelGuide *Section 4.5*.

Adhesive-bonded joints

A wide variety of jointing methods can be used, provided the following simple guidelines are observed:

- Ensure the joint parts are accurately machined.
- Use sharp cutters to avoid tearing or burnishing the surfaces to be bonded.
- Use a high solids content adhesive with low flowing properties such as polyvinyl acetate or urea-formaldehyde.
- Locate mating pieces accurately and hold them under pressure while the adhesive sets.
- Limit the width of grooves machined in CBPB to about one-third of the thickness of the panel. The depth of groove is typically about one-half of the panel thickness.
- Allow adhesive-bonded joints to condition for several days before sanding and finishing; this avoids the appearance of sunken joints and is essential with high-gloss finishes.
- For an efficient tongued and grooved joint, ensure the fit of the joints is not too tight, as this can cause a split along the edge.
- For tongued and grooved flooring, apply the glue liberally to both the tongue and the groove to ensure the entire joint is bonded.
- When attaching lipping, ensure the tongue is machined on the solid wood piece.

Finishing

Where very smooth surfaces are required, pre-sanded panels should be specified. Further information on finishing CBPB is provided in PanelGuide *Section 4.7*.

Health and safety

In panel or processed form CBPB does not present any health or safety risk. Contact with wood products and cement can cause irritation effects but the most significant risks come from mishandling the material.

Dust

CBPB will generate large quantities of very fine dust when it is machined; this is a potentially hazardous substance that must be controlled.

Dust from cutting operations can be controlled adequately by complying with the Control of Substances Hazardous to Health (COSHH) Regulations 2002. Under these Regulations CBPB dust has a Workplace Exposure Limit (WEL) of 5 mg/m^2 expressed as an 8-hour time-weighted average. Exposure must be reduced as far as possible below this limit, usually with properly designed and maintained dust extraction equipment fitted to woodworking machines.

Extraction equipment is often not practicable or even available when using portable or hand-held tools, so a suitable dust mask should be worn. If possible, work in a well-ventilated place.

Table A2.19: CBPB – common hazards and methods of control

Activity	Hazard	Control
Manual handling (in full panel form)	Large panel sizes and significant weight of CBPB present a risk of strain or crush injuries if not handled correctly	• Store carefully in uniform stacks on a flat level base • Use mechanical handling equipment • Adopt correct manual handling procedures
Carpentry work Activities likely to produce high dust levels include: • Sanding by machine and hand • Sawing, routing and turning • Hand assembling machined or sanded components	• Wood dust in general (including dust from CBPB) has health risks – it may cause dermatitis and allergic respiratory effects • Wood dust is flammable	• Off site: preparation under exhaust ventilated plant • On site: enclosure and exhaust ventilation • Dust extraction on portable tools • Good ventilation • Respiratory protection equipment (RPE) Note: Any health hazards arising from the use of CBPB at work can and should be controlled by compliance with the requirements of the Control of Substances Hazardous to Health (COSHH) Regulations 2002.

Further information on dust and dust masks is given in PanelGuide *Section 6.3*.

Formaldehyde

Uncoated CBPB manufactured using Portland cement does not require to be tested for formaldehyde and is automatically rated as Class E1. Uncoated panels therefore have an E1 rating.

Hazards and control

In panel or processed form, CBPB is non-classifiable under the COSHH Regulations. However, there may be handling hazards, especially so on account of its high density.

COSHH Regulation 6 requires an assessment to be made (and normally recorded) of health risks associated with wood dust or formaldehyde together with any action needed to prevent or control those hazards.

Table A2.19 presents the most common hazards and identifies control methods to minimise the risk of harm actually occurring. More detailed information is given in PanelGuide *Section 6.3* and by the Health and Safety Executive.

References

1 BS EN 634-1. Cement-bonded particle boards. Specification. General, BSI

2 BS EN 634-2. Cement-bonded particleboards. Specification. Requirements for OPC bonded particle-boards for use in dry, humid and exterior conditions, BSI

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