TECHNICAL GUIDANCE

GUIDANCE FOR THE USE OF BUILDING BOARDS WITH A1 OR A2 REACTION TO FIRE CLASSIFICATIONS IN FLAT ROOFING

SPRA
Single Ply Roofing Association

LRWA
Liquid Roofing and Waterproofing Association

NFRC
LEADING ROOFING EXCELLENCE

CONTENTS

1. EXECUTIVE SUMMARY

In a cross-industry approach, the *Single Ply Roofing Association* (SPRA), *Liquid Roofing and Waterproofing Association* (LRWA) and *National Federation of Roofing Contractors* (NFRC) have worked with relevant manufacturers to produce a guidance document about the use of building boards with A1 or A2 reaction to fire classifications (formerly referred to as *non-combustible* and *of limited combustibility*, respectively) as structural flat roof decks; structural abutment wall upstands (including parapets); and acoustic mass layers, thermal barriers, cover boards and/or recovery boards in flat roof overlays. Some of the materials being considered do not have third-party approvals for their proposed flat roofing application(s) and, in some cases, *LABC Warranty*, *NHBC Warranty*, *Premier Guarantee* and *Zurich Municipal* projects have advised against the use of such materials completely. The aim is to ensure that the correct guidance is available to respective members and specifiers, thereby preventing misleading and inappropriate product claims.

By changing a material specification to include alternative components, the authorising party assumes design liability for the construction. There is a duty of care on the part of the *designer** to ensure that any alternative components are fit for purpose; compatible with other components; and approved for use by all manufacturers and suppliers who would issue a warranty for the flat roofing system and/or its components, which otherwise may become invalid.

Based upon the literature and test reports supplied by relevant manufacturers of building boards with A1 or A2 reaction to fire classifications, the following table's traffic light system indicates the flat roofing applications in which such products should not be used; may be used; or where caution should be exercised. The traffic light system and subsequent explanatory text are for guidance only. Designers, specifiers and contractors should request third-party approvals and/or written clarification from a manufacturer or supplier to confirm their products' suitability for use in a given flat roofing application prior to writing or changing a material specification. A detailed questionnaire is available in Annex 1. NB. At the date of publication, no contribution to this guidance document has been made by any manufacturers or suppliers of Calcium Silicate building boards.

APPLICATION	CALCIUM SILICATE	CEMENT-BONDED PARTICLEBOARD	FIBRE CEMENT	GYPSUM (MAT-REINFORCED)	MAGNESIUM OXIDE
STRUCTURAL FLAT ROOF DECK	🔴	🟠	🔴	🔴	🔴
STRUCTURAL ABUTMENT/PARAPET	🔴	🟠	🔴	🔴	🔴
ACOUSTIC MASS LAYER	🔴	🟢	🟢	🟢	🟠
THERMAL BARRIER	🔴	🟢	🟢	🟢	🟠
COVER BOARD	🔴	🟢	🟢	🟢	🟠
RECOVERY BOARD	🔴	🟢	🟢	🟢	🟠

Key 🔴 Should not be used; 🟠 Caution should be exercised; 🟢 May be used

* According to the Construction (Design and Management) Regulations 2015, *'Designers can be architects, consulting engineers, quantity surveyors and interior designers, or anyone who specifies and alters designs as part of their work. They can also be principal contractors, specialist contractors, tradespeople or even commercial clients, if they get actively involved in design work for their project.'*

While researching this guidance document, it became apparent that the names of the different types of building boards with A1 or A2 reaction to fire classifications are often abbreviated, used interchangeably and/or used incorrectly. For example, one may refer to a 'Cement' board, which creates confusion as to whether they are referring to a Cement-Bonded Particleboard or Fibre Cement board. When working with such building boards, the reader is advised to clarify the exact type to avoid confusion and potentially incorrect specification.

DISCLAIMER

The *Single Ply Roofing Association* (SPRA), *Liquid Roofing and Waterproofing Association* (LRWA), *National Federation of Roofing Contractors* (NFRC) and any contributors believe that the guidance and information contained in this document is correct at the date of publication. All parties must rely on their own skill and judgement when making use of it.

This guidance document is not exhaustive and building designers will be required to check constructions against guidance for a number of functional standards. It is recommended that project specifics are discussed with the local authority and a qualified fire engineer, particularly when following alternative guidance or a fire safety engineered approach.

National Building Regulations are intended to ensure a reasonable standard of life safety in a fire. The protection of property, including the building itself, often requires additional measures. Insurers usually set higher standards before accepting the insurance risk. Many insurers use the *RISCAuthority Design Guide for the Fire Protection of Buildings* by the *Fire Protection Association* (FPA) as a basis for providing guidance to the building designer on what they require. Further information on the protection of property can be obtained from the FPA website: www.thefpa.co.uk.

Neither SPRA, LRWA, NFRC, nor any contributor assumes any liability to anyone for any loss or damage caused by any error or omission in this guidance document, whether such error or omission is the result of negligence or any other cause. Where reference is made to legislation, it is not to be considered as legal advice. Any and all such liability is disclaimed.

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2. INTRODUCTION

Within the flat roofing industry, there is a growing demand for products with A1 or A2 reaction to fire classifications (formerly referred to as *non-combustible* and *of limited combustibility*, respectively) to be used as alternatives to OSB3 and plywood. This is due to the apparent drive of Approved Document B towards the increased use of less combustible flat roof decks and the fluctuation in prices and supply of building materials. It has resulted in an increasing number of enquiries to the *Single Ply Roofing Association* (SPRA), *Liquid Roofing and Waterproofing Association* (LRWA), *National Federation of Roofing Contractors* (NFRC) and their members about the use of building boards with A1 or A2 reaction to fire classifications in flat roofing applications. Some of the materials being considered do not have third-party approvals for their proposed flat roofing application(s) and, in some cases, *LABC Warranty*, *NHBC Warranty*, *Premier Guarantee* and *Zurich Municipal* projects have advised against the use of such materials completely.

By changing a material specification to include alternative components, the authorising party assumes design liability for the construction. There is a duty of care on the part of the *designer** to ensure that any alternative components are fit for purpose; compatible with other components; and approved for use by all manufacturers and suppliers who would issue a warranty for the flat roofing system and/or its components, which otherwise may become invalid.

In a cross-industry approach to this matter, SPRA, LRWA and NFRC have worked with relevant manufacturers to produce a guidance document about the use of building boards with A1 or A2 reaction to fire classifications as structural flat roof decks; structural abutment wall upstands (including parapets); and acoustic mass layers, thermal barriers, cover boards and/or recovery boards in flat roof overlays. The aim is to ensure that the correct guidance is available to their members and specifiers, thereby preventing misleading and inappropriate product claims. As there is no current industry standard for the use of these materials in flat roofing applications, we expect all manufacturers of building boards with A1 or A2 reaction to fire classifications to follow the guidance set out in the *Code for Construction Product Information* (CCPI). Clause 5 states specifically that, *'A Manufacturer must provide specific documentation when making any product performance claims which are outside of Certification, Classification or Industry Standard tests;*

- *All stated performance data must be referenced back to a valid dated test or specified technical assessment*
- *Where a test is referenced, it must state the Construction Product tested, the test, date passed, under what standard, where tested and by whom and the last date its validity was reviewed*
- *Stated performance data must be clear as to whether it is based on calculated and/or tested performance and manufacturers must clearly state where tests are laboratory tests;*
- *Specific properties relevant to intended application must be clear e.g., structural/fire/acoustic/ thermal*
- *Be specific to the intended application and where known, provide examples of limitations or inappropriate applications.'*

In accordance with the CCPI, we encourage manufacturers of building boards with A1 or A2 reaction to fire classifications to have their products certified by a relevant, accredited third-party certification body (refer to the gov.uk database) and assessed for use in their specific, intended flat roofing application(s). Any third-party approval referenced to support the marketing of a product for use in a flat roofing application must list said flat roofing application (not any roofing application) in its scope. In the meantime, manufacturers should seek written clarification from the principal designer and/or building control authority as to what their requirements are prior to writing any specification.

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* According to the Construction (Design and Management) Regulations 2015, *'Designers can be architects, consulting engineers, quantity surveyors and interior designers, or anyone who specifies and alters designs as part of their work. They can also be principal contractors, specialist contractors, tradespeople or even commercial clients, if they get actively involved in design work for their project.'*

3. FIRE CLASSIFICATION OF CONSTRUCTION PRODUCTS

3.1 REACTION TO FIRE*

Reaction to fire relates to the degree to which a product will contribute, by its own decomposition, to a fire under specified conditions. Products, other than floorings, are classified as A1, A2, B, C, D, E or F (with class A1 being the highest performance and F being the lowest) in accordance with EN 13501-1 *Fire classification of construction products and building elements. Classification using data from reaction to fire tests.* Untested products cannot be classified in accordance with EN 13501-1.

- **A1 and A2 (s1, d0)** Formerly referred to as *non-combustible*
- **A2 – excluding A2 (s1, d0)** Formerly referred to as *of limited combustibility*
- **B, C, D, E and F** Increasing contributions to fire from B to F

PRODUCTION OF SMOKE AND FLAMING DROPLETS/PARTICLES

The classes of reaction to fire performance of A2, B, C and D are accompanied by additional classifications related to the production of smoke (s1, s2, s3), with s1 indicating the lowest production, and/or flaming droplets/particles (d0, d1, d2), with d0 indicating the lowest production. When a classification includes s3, d2 this means that there is no limit set for smoke production and/or flaming droplets/particles.

Smoke Growth Rate (SMOGRA) is the rate at which smoke production increases during the full 20-minute exposure period. Total Smoke Production (TSP) is the total smoke produced during the evaluation period.

- **s1** SMOGRA ≤30m²/s² and TSP ≤50m² within the evaluation period
- **s2** SMOGRA ≤180m²/s² and TSP ≤200m² within the evaluation period
- **s3** Product does not comply with either of the above

- **d0** No flaming droplets/particles occur within the evaluation period
- **d1** No flaming droplets/particles lasting longer than ten seconds occur within the evaluation period
- **d2** Product does not comply with either of the above

3.2 EXTERNAL FIRE EXPOSURE TO ROOFS**

Performance of the resistance of roofs to external fire exposure is measured in terms of penetration through the roof construction and the spread of flame over its surface. Roof constructions are classified in accordance with EN 13501-5 *Fire classification of construction products and building elements. Classification using data from external fire exposure to roofs tests.* EN 13501-5 refers to four separate roof tests as detailed in DD CEN/TS 1187 *Test methods for external fire exposure to roofs*, with Test 4 (t4) applicable in the United Kingdom and Ireland. Roof constructions are classified as $B_{ROOF}(t4)$, $C_{ROOF}(t4)$, $D_{ROOF}(t4)$, $E_{ROOF}(t4)$ or $F_{ROOF}(t4)$. The highest performance is indicated by $B_{ROOF}(t4)$ and the lowest by $F_{ROOF}(t4)$.

Refer to the latest version of all referenced standards, codes and literature unless otherwise stated.

* There may be some products lawfully on the market using national classifications for reaction to fire. Where this is the case, Table B1 of Approved Document B (volumes 1 and 2) outlines how classifications in accordance with EN 13501-1 may be transposed to national classifications.

** There may be some products lawfully on the market using national classifications for the performance of the resistance of roofs to external fire exposure. Where this is the case, Table B2 of Approved Document B (volumes 1 and 2) outlines how classifications in accordance with EN 13501-5 may be transposed to national classifications.

4. TYPES OF BUILDING BOARDS WITH A1 OR A2 REACTION TO FIRE CLASSIFICATIONS

While researching this guidance document, it became apparent that the names of the different types of building boards with A1 or A2 reaction to fire classifications are often abbreviated, used interchangeably and/or used incorrectly. For example, one may refer to a 'Cement' board, which creates confusion as to whether they are referring to a Cement-Bonded Particleboard or Fibre Cement board. When working with such building boards, the reader is advised to clarify the exact type to avoid confusion and potentially incorrect specification.

4.1 CALCIUM SILICATE

Calcium Silicate building boards are used for acoustic insulation, passive fire protection and thermal insulation. Those used for thermal insulation are manufactured in accordance with EN 16977 *Thermal insulation products for buildings. Factory made calcium silicate (CS) products. Specification.*

At the date of publication, no contribution to this guidance document has been made by any manufacturers or suppliers of Calcium Silicate building boards. Designers, specifiers and contractors are advised to exercise caution when considering the use of Calcium Silicate building boards in flat roofing applications.

4.2 CEMENT-BONDED PARTICLEBOARD

Particleboard, as defined in EN 309 *Particleboards. Definition and classification,* is a *'panel material manufactured under pressure and heat from particles of wood (wood flakes, chips, shavings, sawdust and similar) and/or other lignocellulosic material in particle form (flax shives, hemp shives, bagasse fragments, straw and similar), with the addition of a polymeric adhesive.'*

Particleboards are also available in which a cementitious binder, usually Ordinary Portland Cement (OPC), is used. Cement-bonded particleboards are produced in accordance with EN 634-1 *Cement-bonded particleboards. Specification. General Requirements* and EN 634-2 *Cement-bonded particleboards. Specifications. Requirements for OPC bonded particleboards for use in dry, humid and external conditions.* Cement-Bonded Particleboards can be bonded with OPC or with magnesium-based cements. EN 634-2 relates only to OPC-bonded boards.

Cement-Bonded Particleboards must be CE, UKCA and/or UKNI marked in accordance with EN 13986 *Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking.*

4.3 FIBRE CEMENT

Fibre Cement building boards are a lightweight composite material consisting of a core made of Ordinary Portland Cement (OPC), limestone, other materials (such as clay, expanded perlite, iron, or sand) and a small amount of other chemical additives to help the manufacturing process or provide a board with particular characteristics. The boards are reinforced with cellulose or glass fibres.

Refer to the latest version of all referenced standards, codes and literature unless otherwise stated.

In Fibre Cement building boards with glass fibre reinforcement, the dual-sided reinforcement consists of a glass fibre fabric as well as a dual-sided top layer (named *slurry*) made of OPC and limestone powder. The reinforcement mesh is embedded in the slurry. The glass fibre fabric can have a nominal weight per unit area of either 100g/m² or 125g/m².

Fibre Cement building boards must be CE, UKCA and/or UKNI marked in accordance with EN 12467 *Fibre-cement flat sheets. Product specification and test methods.*

4.4 GYPSUM (MAT-REINFORCED)

Gypsum is a solid, white, mined or synthetic material, composed of Calcium Sulphate Dihydrate. Mat-reinforced Gypsum building boards have a core of aerated gypsum bonded between two sheets of fibreglass.

To produce mat-reinforced Gypsum building boards, crushed natural Gypsum or synthetic Gypsum is heated or calcined to dehydrate the feedstock. The calcined Gypsum is mixed with water and additives to form a slurry, which is fed between continuous layers of fibreglass on a long board machine. As the board moves down a conveyor line, the Calcium Sulphate recrystallizes or rehydrates, reverting to its original rock state. The fibreglass becomes chemically and mechanically bonded to the core. The board is then cut to length and conveyed through dryers to remove any free moisture.

Mat-reinforced Gypsum building boards must be CE, UKCA and/or UKNI marked in accordance with the following designated/harmonised standard:

- **EN 15283-1** Gypsum boards with fibrous reinforcement. Definitions, requirements and test methods. Gypsum boards with mat reinforcement

4.5 MAGNESIUM OXIDE

Magnesium Oxide building boards are a generic group of building boards used widely in construction industries throughout the world. They can be divided into two types: Magnesium Oxychloride or Magnesium Oxysulfate. Combined, these two types account for over 99% of Magnesium Oxide building boards used in the UK.

Research titled *Assessing variability in the hygrothermal performance of Magnesium Oxide (MgO) cladding products of the Australian market* published in 2019 by Nicholas Jays et al. concludes:

> *We have observed significant variance in the quality of Magnesium Oxide boards available for construction in the Australian market. Reports of damage such as dampness and accelerated corrosion of metallic fasteners can be attributed to the hygroscopic nature of magnesium oxychloride, which is used as the binder in many MgO boards. High chloride concentrations in the binders are prone to absorbing water at high relative humidities and may lead to chloride containing leachate. These leachates can attack non-stainless-steel fasteners and teardrop formation itself creates problems even in the absence of ferrous fasteners. There is therefore a need for an industry-based system to classify and categorise commercially available MgO boards into those that will not degrade in high RH environments.*

Further research titled *Hygroscopic Performance of Sulphate-Based MgO Construction Boards* published in 2022 by Ayodele Olofinjana et al. notes that:

> *Such corrosion actions were not observed in [Magnesium Oxysulfate] MOS boards.*

In 2021, the *Magnesium Oxide Building Board Trade Association* (MOBBTA) sponsored the publication of a Publicly Available Specification (PAS). PAS 670 *Magnesium oxide-based boards for use in buildings. Specification* specifies requirements for flat sheet building boards manufactured using Magnesium Oxychloride or Magnesium Oxysulfate for the purpose of partitioning, lining and encasement of buildings. Other formulations of boards are not covered by the PAS. **The PAS is not applicable to the use of boards as flooring, sarking and roofing.** The introduction to PAS 670 reads as follows:

> *Magnesium Oxide building boards have been used in construction for over twenty years. Typically, they are used as a component in a building. They are generally selected for their strength to weight ratio, structural strength, performance when exposed to fire and workability.*
>
> *However, concerns have been reported, most notably in Denmark in 2015, and also in Australia, where a reaction between boards and water vapour in the air (humidity) led to rapid degradation of the boards which also damaged adjacent components of the building(s).*
>
> *In Denmark the incidents were serious enough to elicit a high-level enquiry and some academic research into the cause of the failure. Despite these steps neither the precise origin of the boards or the exact reasons for failure were determined.*
>
> *This served to highlight that no common standard existed for the selection, testing and verification of the consistency of boards.*
>
> *This PAS provides consensual best practice on how to select, test and verify Magnesium Oxide boards for use in construction. This is achieved using appropriate pre-existing standards for strength and durability testing, reaction to fire, testing requirements specific to the performance of these boards in a humid environment and governance of the manufacturing, supply chains and traceability of boards.*
>
> *This PAS specifies the verification of the consistency of the manufacturing process and the testing of Magnesium Oxide-based boards for use in construction with reference to the following two standards:*
> - ***EN 12467** Fibre-cement flat sheets. Product specification and test methods*
> - ***EN 13501-1** Fire classification of construction products and building elements. Classification using data from reaction to fire tests*

The Foreword to PAS 670 advises users *'to consider the desirability of third-party certification of product conformity to this PAS.'* Given the variance in the quality of Magnesium Oxide building boards available for construction on the market and the reports of accelerated corrosion of metallic fasteners, SPRA, LRWA and NFRC believe third-party approval of all such products for use in any construction application to be essential.

Refer to the latest version of all referenced standards, codes and literature unless otherwise stated.

5. FLAT ROOFING APPLICATIONS

5.1 STRUCTURAL FLAT ROOF DECK

A structural flat roof deck should provide support to a waterproof layer together with (when used) a layer (or layers) of thermal insulation, a layer (or layers) to control the movement of air and vapour (AVCL), and any other layers as required, such as:

- Screeds to create falls
- Acoustic mass layers to improve sound attenuation
- Thermal barriers to improve external and/or internal fire exposure performance
- Cover boards/recovery boards underneath the waterproof covering
- Photovoltaic panels
- Drainage layers in blue, green and protected roof constructions
- Water flow reducing layers in blue, green and protected roof constructions
- Gravel, paving slabs and/or pebble ballast on protected roofs
- Growing media and planting on blue and green roofs
- Attenuated rainwater on a blue roof

A structural flat roof deck should be able to receive proprietary bonding agents, primers, adhesives and/or mechanical fastening systems; able to resist dynamic loads transferred by any such method(s) of attachment; and able to resist dead and imposed loads applied by the layers listed above, as applicable.

5.2 STRUCTURAL ABUTMENT WALL UPSTAND (INCLUDING PARAPETS)

Vertical support structure along one or more elevations of a flat roof. A structural abutment wall upstand (including parapets) should provide support to a waterproof layer together with (when used) a layer (or layers) of thermal insulation , a layer (or layers) to control the movement of air and vapour (AVCL), and any other layers as required, such as those listed below. It should be able to receive proprietary bonding agents, primers, adhesives and/or mechanical fastening systems and able to resist dynamic loads transferred by any such method(s) of attachment.

5.3 ACOUSTIC MASS LAYER

Layer used to attenuate the transmission of airborne noise and impact vibrations through a flat roof construction.

5.4 THERMAL BARRIER

Layer with A1 or A2 reaction to fire classification used to improve the external fire exposure performance and/or the internal fire performance of a flat roof construction.

5.5 COVER BOARD

Building board installed external to a profiled metal structural flat roof deck and/or profiled metal structural abutment wall upstand (including parapets) in a new cold or inverted roof construction to provide continuous support to the waterproofing; or a building board installed between the thermal insulation and waterproof covering (either horizontally or vertically) in a new warm roof construction to improve resistance to wind uplift and/or robustness.

5.6 RECOVERY BOARD

Building board installed over an existing flat roof to be overlaid and underneath the waterproof covering.

6. USES OF BUILDING BOARDS WITH A1 OR A2 REACTION TO FIRE CLASSIFICATIONS IN FLAT ROOFING APPLICATIONS

Based upon the literature and test reports supplied by relevant manufacturers of building boards with A1 or A2 reaction to fire classifications, the following table's traffic light system indicates the flat roofing applications in which such products should not be used; may be used; or where caution should be exercised. The traffic light system and subsequent explanatory text are for guidance only. Designers, specifiers and contractors should request third-party approvals and/or written clarification from a manufacturer or supplier to confirm their products' suitability for use in a given flat roofing application prior to writing or changing a material specification. A detailed questionnaire is available in Annex 1. NB. At the date of publication, no contribution to this guidance document has been made by any manufacturers or suppliers of Calcium Silicate building boards.

For products that may be used in one or more flat roofing applications, their specification as part of a flat roofing system should be approved by all manufacturers and suppliers who would issue a warranty for the flat roofing system and/or its components, which otherwise may become invalid.

APPLICATION	CALCIUM SILICATE	CEMENT-BONDED PARTICLEBOARD	FIBRE CEMENT	GYPSUM (MAT-REINFORCED)	MAGNESIUM OXIDE
STRUCTURAL FLAT ROOF DECK	🔴	🟠	🔴	🔴	🔴
STRUCTURAL ABUTMENT/PARAPET	🔴	🟠	🔴	🔴	🔴
ACOUSTIC MASS LAYER	🔴	🟢	🟢	🟢	🟠
THERMAL BARRIER	🔴	🟢	🟢	🟢	🟠
COVER BOARD	🔴	🟢	🟢	🟢	🟠
RECOVERY BOARD	🔴	🟢	🟢	🟢	🟠

Key 🔴 Should not be used; 🟠 Caution should be exercised; 🟢 May be used

6.1 CALCIUM SILICATE

At the date of publication, no contribution to this guidance document has been made by any manufacturers or suppliers of Calcium Silicate building boards. Designers, specifiers and contractors are advised to exercise caution when considering the use of Calcium Silicate building boards in flat roofing applications.

Refer to the latest version of all referenced standards, codes and literature unless otherwise stated.

6.2 CEMENT-BONDED PARTICLEBOARD

USE AS A STRUCTURAL FLAT ROOF DECK AND/OR STRUCTURAL ABUTMENT WALL UPSTAND

In addition to those declared according to EN 13986 *Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking,* Cement-Bonded Particleboards manufactured for use as a structural flat roof deck and/or structural abutment wall upstand (including parapets) must have extra performance characteristics determined and structural calculations completed according to EN 12871 *Wood-based panels. Determination of performance characteristics for load bearing panels for use in floors, roofs and walls.* Refer to Annex 2 of this guidance document for further information. The use of a Cement-Bonded Particleboard in a structural flat roofing application should be approved by a third party.

The design loads and suitability of a mechanical fastening system should be determined by product- and assembly-specific, third-party testing and approval related to the intended structural flat roofing application(s). At the date of publication, we are unaware of any such approvals. Manufacturers and suppliers of Cement-Bonded Particleboards are required to undertake such testing and approvals in conjunction with manufacturers and suppliers of mechanical fastening systems.

USE AS AN ACOUSTIC MASS LAYER, COVER BOARD, OR RECOVERY BOARD

When used as an acoustic mass layer, cover board, or recovery board, Cement-Bonded Particleboards can be mechanically fastened to a structural flat roof deck or adhered to a suitably attached substrate, subject to wind load. The suitability of a mechanical fastening system should be determined as outlined above. The selection of bonding agents, primers and adhesives should be based on the advice of the relevant manufacturer(s) or supplier(s) and the compatibility of materials. Cement-Bonded Particleboards are used widely in structural flooring applications, so they should be able to withstand foot traffic.

USE AS A THERMAL BARRIER

Cement-Bonded Particleboards may be classified A2 s1, d0 in accordance with EN 13501-1 *Fire classification of construction products and building elements. Classification using data from reaction to fire tests,* therefore they may be suitable for use as a thermal barrier within a flat roof construction. Generally, Cement-Bonded Particleboards have not been used in any of the applications listed above as part of a flat roof construction tested in accordance with DD CEN/TS 1187 (test 4) *Test methods for external fire exposure to roofs,* however, which would allow such a construction to be classified in accordance with EN 13501-5 *Fire classification of construction products and building elements. Classification using data from external fire exposure to roofs tests.* The reader is advised to check with individual system manufacturers and suppliers.

DELIVERY, STORAGE AND HANDLING

Cement-Bonded Particleboards should be received in a dry state with pallets protected from weather with plastic sheeting or similar. Boards should be stored on flat, dry pallets elevated on skids/battens sufficiently from ground level to prevent board wetting. If boards are stored on site for a long period of time they should be kept under cover/indoors if possible. When manually moving boards they should be carried in a vertical orientation.

6.3 FIBRE CEMENT

USE AS A STRUCTURAL FLAT ROOF DECK AND/OR STRUCTURAL ABUTMENT WALL UPSTAND

Fibre Cement building boards do not fall within the scope of EN 13986, nor the scope of EN 12871. The suitability of a Fibre Cement building board for use as a structural flat roof deck and/or structural abutment wall upstand (including parapets) would have to be determined by a European or UK Technical Assessment (ETA/UKTA) using a European or UK Assessment Document (EAD/UKAD) and/or by third-party testing and approval.

USE AS AN ACOUSTIC MASS LAYER, COVER BOARD, OR RECOVERY BOARD

When used as an acoustic mass layer, cover board, or recovery board, Fibre Cement building boards can be mechanically fastened to a structural flat roof deck or adhered to a suitably attached substrate, subject to wind load. The design loads and suitability of a mechanical fastening system should be determined by product- and assembly-specific, third-party testing and approval related to the intended flat roofing application(s). The selection of bonding agents, primers and adhesives should be based on the advice of the relevant manufacturer(s) or supplier(s) and the compatibility of materials. Fibre Cement building boards are used widely in structural flooring applications, so they should be able to withstand foot traffic.

USE AS A THERMAL BARRIER

Fibre Cement building boards may be classified A1 in accordance with EN 13501-1, therefore they may be suitable for use as a thermal barrier within a flat roof construction. Generally, Fibre Cement building boards have not been used in any of the applications listed above as part of a flat roof construction tested in accordance with DD CEN/TS 1187 (test 4), however, which would allow such a construction to be classified in accordance with EN 13501-5. The reader is advised to check with individual system manufacturers and suppliers.

DELIVERY, STORAGE AND HANDLING

Fibre Cement building boards must be protected from the effects of moisture and weather before installation. Boards that have become damp must be dried on both sides before use. Allow time for the boards to acclimatise to the ambient temperature and moisture conditions before installation. The material, ambient air and background temperature must not be below +5°C. Always carry boards upright using a board trolley or on a pallet using a forklift truck. When setting the boards down, make sure that corners and edges are not damaged.

6.4 GYPSUM (MAT-REINFORCED)

USE AS A STRUCTURAL FLAT ROOF DECK AND/OR STRUCTURAL ABUTMENT WALL UPSTAND

Mat-reinforced Gypsum building boards do not fall within the scope of EN 13986, nor the scope of EN 12871. The suitability of a mat-reinforced Gypsum building board for use as a structural flat roof deck and/or structural abutment wall upstand (including parapets) would have to be determined by a European or UK Technical Assessment (ETA/UKTA) using a European or UK Assessment Document (EAD/UKAD) and/or by third-party testing and approval.

USE AS AN ACOUSTIC MASS LAYER, COVER BOARD, OR RECOVERY BOARD

When used as an acoustic mass layer, cover board, or recovery board, mat-reinforced Gypsum building boards can be mechanically fastened to a structural flat roof deck or adhered to a suitably attached

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Refer to the latest version of all referenced standards, codes and literature unless otherwise stated.

substrate, subject to wind load. The design loads and suitability of a mechanical fastening system should be determined by product- and assembly-specific, third-party testing and approval related to the intended flat roofing application(s). The selection of bonding agents, primers and adhesives should be based on the advice of the relevant manufacturer(s) or supplier(s) and the compatibility of materials. Mat-reinforced Gypsum building boards perform well under normal construction and maintenance foot traffic.

USE AS A THERMAL BARRIER

Mat-reinforced Gypsum building boards may be classified A1 in accordance with EN 13501-1, therefore they may be suitable for use as a thermal barrier within a flat roof construction. Generally, mat-reinforced Gypsum building boards have not been used in any of the applications listed above as part of a flat roof construction tested in accordance with DD CEN/TS 1187 (test 4), however, which would allow such a construction to be classified in accordance with EN 13501-5. The reader is advised to check with individual system manufacturers and suppliers.

DELIVERY, STORAGE AND HANDLING

Mat-reinforced Gypsum building boards must be protected from exposure to moisture before, during and after installation. The presence of moisture can have a detrimental effect on the performance of the product and the installation of roofing membranes. Boards stored outside must be stored level and off the ground and protected by a waterproof covering. Provide means for air circulation around and under stored bundles of boards. Use adequate supports to keep the bundles flat, level and dry. Moisture can cause blisters to form during hot mopping or torching to any substrate. Typically, any excess moisture will vaporise and travel upward into the interface between the membrane and substrate rather than dissipating within the board. In fully adhered single ply or cold mastic bitumen systems, the evaporation of solvents may be restricted and may cause solvent blisters. Moisture accumulation may adversely affect the structural stability or bond of roofing system components and may significantly decrease wind uplift and vertical pull resistance in the system or assembly. Boards exposed to moisture may need to be evaluated for structural stability to assure wind uplift performance. Care should also be taken during installation to avoid the accumulation of moisture in the system. Boards must be covered the same day as installed. Avoid application of boards during rain, heavy fog and any other conditions that may deposit moisture on the surface, and avoid the overuse of non-vented, direct-fired heaters during winter months. Care must be taken after installation to avoid and properly manage leaks and other water accumulation.

6.5 MAGNESIUM OXIDE

COMPATIBILITY WITH OTHER MATERIALS (REFER ALSO TO SECTION 4.5)

There are concerns surrounding the use of Magnesium Oxide building boards in climates where the Relative Humidity (RH) exceeds 84%, at which point Magnesium Oxide building boards may begin to absorb excessive amounts of moisture from surrounding air and leach drops of salty water, which may be absorbed by wooden structures and lead to mould growth. Magnesium Oxide building boards themselves may be sensitive to mould growth due to their organic content and may disintegrate over time when exposed to high humidity, due to the dissolution of salts.

Salts from Magnesium Oxide building boards are potentially highly corrosive to metal fasteners and stress plates. Should corrosion occur, it could lead directly to the structural failure of a mechanical fastening system. For this reason, any Magnesium Oxide building board specified for use in a flat roofing application should

be approved for use in said flat roofing application by a third party. The third-party approval must include an assessment of the corrosion risk to mechanical fastening systems should the Magnesium Oxide building board become wet. At the date of publication, we are unaware of any such approvals. Manufacturers and suppliers of Magnesium Oxide building boards are required to undertake such testing and approvals in conjunction with manufacturers and suppliers of mechanical fastening systems. In the absence of a third-party approval, the use of a Magnesium Oxide building board in conjunction with a mechanical fastening system may invalidate the required fastener warranty. The authorising party would assume design liability for the construction. The implications should be checked with the appropriate flat roofing system and fastener suppliers.

The effects of salts from Magnesium Oxide building boards on profiled steel roof decks, wood-based panel roof decks, and flat roof waterproof coverings is unknown. These too should be subjected to third-party testing and approval.

USE AS A STRUCTURAL FLAT ROOF DECK AND/OR STRUCTURAL ABUTMENT WALL UPSTAND

Magnesium Oxide building boards do not fall within the scope of EN 13986, nor the scope of EN 12871. The suitability of a Magnesium Oxide building board for use as a structural flat roof deck and/or structural abutment wall upstand (including parapets) would have to be determined by a European or UK Technical Assessment (ETA/UKTA) using a European or UK Assessment Document (EAD/UKAD) and/or by third-party testing and approval.

USE AS AN ACOUSTIC MASS LAYER, COVER BOARD, OR RECOVERY BOARD

When used as an acoustic mass layer, cover board, or recovery board, Magnesium Oxide building boards can be adhered to a suitably attached substrate, subject to wind load. The selection of bonding agents, primers and adhesives should be based on the advice of the relevant manufacturer(s) or supplier(s) and the compatibility of materials. The design loads and suitability of a mechanical fastening system should be determined by product- and assembly-specific, third-party testing and approval related to the intended flat roofing application(s). The third-party approval must include an assessment of the corrosion risk to mechanical fastening systems should the Magnesium Oxide building board become wet. Magnesium Oxide building boards with a thickness of ≥20mm should be able to withstand light foot traffic.

USE AS A THERMAL BARRIER

Magnesium Oxide building boards may be classified A1 in accordance with EN 13501-1, therefore they may be suitable for use as a thermal barrier within a flat roof construction. Generally, Magnesium Oxide building boards have not been used in any of the applications listed above as part of a flat roof construction tested in accordance with DD CEN/TS 1187 (test 4), however, which would allow such a construction to be classified in accordance with EN 13501-5. The reader is advised to check with individual system manufacturers and suppliers.

DELIVERY, STORAGE AND HANDLING

Magnesium Oxide building boards are delivered secured to a pallet, with the edges and corners protected. Boards should be stored flat either on the pallet used for delivery or supports with 800mm centres. Boards should be stored inside where possible and covered when stored outside. Boards should be carried vertically to prevent stress and/or damage to the boards.

7. RELEVANT STANDARDS, CODES AND LITERATURE

Refer to the latest version unless otherwise stated.

- **BS 6229** Flat roofs with continuously supported flexible waterproof coverings. Code of practice
- **BS 8217** Reinforced bitumen membranes for roofing. Code of practice
- **EN 309** Particleboards. Definition and classification
- **EN 321** Wood-based panels. Determination of moisture resistance under cyclic test conditions
- **EN 594** Timber structures. Test methods. Racking strength and stiffness of timber frame wall panels
- **EN 596** Timber structures. Test methods. Soft body impact test of timber framed walls
- **EN 634-1** Cement-bonded particleboards. Specification. General requirements
- **EN 634-2** Cement-bonded particleboards. Specifications. Requirements for OPC bonded particleboards for use in dry, humid and external conditions
- **EN 789** Timber structures. Test methods. Determination of mechanical properties of wood based panels
- **EN 1058** Wood-based panels. Determination of characteristic 5-percentile values and characteristic mean values
- **EN 1156** Wood-based panels. Determination of duration of load and creep factors
- **EN 1195** Timber structures. Test methods. Performance of structural floor decking
- **EN 1990** Eurocode. Basis for structural design
- **EN 1991-1-1** Eurocode 1. Actions on structures. General actions. Densities, self-weight, imposed loads for buildings
- **EN 1991-1-3** Eurocode 1. Actions on structures. General actions. Snow loads
- **EN 1991-1-4** Eurocode 1. Actions on structures. General actions. Wind actions
- **EN 1995-1-1** Eurocode 5. Design of timber structures. General. Common rules and rules for buildings
- **EN 12467** Fibre-cement flat sheets. Product specification and test methods
- **EN 12871** Wood-based panels. Determination of performance characteristics for load bearing panels for use in floors, roofs and walls
- **EN 13501-1** Fire classification of construction products and building elements. Classification using data from reaction to fire tests
- **EN 13501-5** Fire classification of construction products and building elements. Classification using data from external fire exposure to roofs tests
- **EN 13956** Flexible sheets for waterproofing, Plastics and rubber sheets for roof waterproofing. Definitions and characteristics
- **EN 13986** Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking
- **EN 15283-1** Gypsum boards with fibrous reinforcement. Definitions, requirements and test methods. Gypsum boards with mat reinforcement
- **EN 16002** Flexible sheets for waterproofing. Determination of the resistance to wind load of mechanically fastened flexible sheets for roof waterproofing
- **EN 16977** Thermal insulation products for buildings. Factory made calcium silicate (CS) products. Specification
- **DD CEN/TS 1187** Test methods for external fire exposure to roofs
- **PAS 670** Magnesium oxide-based boards for use in buildings. Specification

- **Assessing Variability in the Hygrothermal Performance of Magnesium Oxide (MgO) Cladding Products of the Australian Market** Nicholas Jays, Ayodele Olofinjana, David James Young
- **BRE Digest 477 Part 3** Wood-based panels: cement-bonded particleboard
- **Hygroscopic Performance of Sulphate-Based MgO Construction Boards** Ayodele Olofinjana, Nicholas Jays, David Young, Jitendra Mata, and Rezwanul Haque
- **LABC Warranty** Technical Manual Version 10
- **Moisture Damage with Magnesium Oxide Boards in Danish Facade Structures** Carsten Rode, Tommy Bunch-Nielsen, Kurt Kielsgaard Hansen, Bent Grelk
- **NHBC Standards (2021)** Chapter 7.1 Flat roofs, terraces and balconies
- **Premier Guarantee** Technical Manual Version 14
- **SPRA Technical Guidance S15/19** Site Pull-Out Test Protocol for Flat Roofs
- **The Building Regulations 2010 (as amended – for use in England)** Approved Document B
- **The Building Regulations (Northern Ireland) 2012 (as amended)** Technical Booklet E
- **The Building (Scotland) Regulations 2004 (as amended)** Building Standards Technical Handbooks Section 2
- **Wood Panel Industries Federation** Panel Guide Version 4.1

ANNEX 1: QUESTIONNAIRE

Manufacturers and suppliers of building boards with A1 or A2 reaction to fire classifications were invited to complete the following questionnaire. Designers, specifiers and contractors are encouraged to ask the same questions of manufacturers and suppliers when considering the use of such products in flat roofing applications.

FIRE CLASSIFICATION AND REACTION TO HEAT

- Do any of your products achieve a reaction to fire classification of A2-s3, d2 or better to EN 13501-1 *Fire classification of construction products and building elements – Classification using data from reaction to fire tests*?
- Have any of your products been classified to EN 13501-5 *Fire classification of construction products and building elements – Classification using data from external fire exposure to roofs tests*?
- Do any of your products display adverse reactions to heat, for example, structural changes in reaction to the application of hot bitumen adhesives?

FLAT ROOFING APPLICATIONS

- Are any of your products tested and certified for use in any of the following flat roofing applications? Structural flat roof deck; structural abutment wall upstand (including parapets); acoustic insulation layer; thermal barrier; recovery board in a flat roof overlay.
- If tested and certified for use as a structural flat roof deck and/or structural abutment wall upstand (including parapets), can your products span between supports or must they be fully supported?
- Please provide any other relevant information regarding your products' structural strengths when used as a structural flat roof deck and/or structural abutment wall upstand (including parapets).
- Are there any restrictions on your products' exposure to moisture?
- Are your products installed using adhesives and/or mechanical fasteners?
- If/when your products are mechanically fastened, do you recommend a fastener pattern and/or a minimum number of fasteners per square metre?
- If/when your products are mechanically fastened, are there any restrictions on the grade/type of metal used for the fasteners?
- Are your products suitable to receive insulation and waterproofing membranes in *mechanically fastened* systems?
- Do you have any data regarding the pull-out resistance of your products relative to different board thicknesses and fastener types?
- Are your products suitable to receive insulation and waterproofing membranes in *adhered* systems?
- In the case of *adhered* flat roofing systems, are there any restrictions on the use of primers or adhesives with your products?

COMPATIBILITY WITH FASTENERS

- What is the pH of your product when suspended in an aqueous solution?
- What was the concentration of the aqueous solution that was tested?
- What tolerances apply to the pH of your product?
- How are the pH tolerances of your product managed during manufacture?
- If no data regarding the specific pH of your product is available, does it become acidic or alkaline when in contact with moisture?

ANNEX 2: CEMENT-BONDED PARTICLEBOARD

Cement-Bonded Particleboards must be manufactured according to EN 634-2 *Cement-bonded particleboards. Specifications. Requirements for OPC bonded particleboards for use in dry, humid and external conditions* and CE/NI/UKCA marked according to EN 13986 *Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking.* Those manufactured for use as a structural flat roof deck and/or abutment wall upstand (including parapets) must have the following performance characteristics determined:

- **Bending strength and bending stiffness (modulus of elasticity)** tested according to EN 789 *Timber structures. Test methods. Determination of mechanical properties of wood based panels* and calculated according to EN 1058 *Wood-based panels. Determination of characteristic 5-percentile values and characteristic mean values*
- **Durability (moisture resistance)** by testing both the internal bond and the swelling in thickness after the cyclic test EN 321 *Wood-based panels. Determination of moisture resistance under cyclic test conditions*
- **Strength and stiffness under point load for structural use (roof decking on joists)** determined and evaluated according to EN 12871 *Wood-based panels. Determination of performance characteristics for load bearing panels for use in floors, roofs and walls*
- **Racking resistance (wall sheathing on studs)** determined according to EN 594 *Timber structures. Test methods. Racking strength and stiffness of timber frame wall panels*
- **Mechanical durability** determined according to EN 1156 *Wood-based panels. Determination of duration of load and creep factors* for the deformation factor (k_{def}) and modification factor (k_{mod})

EN 12871 specifies concentrated load test and assessment methods for roof decking and soft body impact assessment methods and classification system for roofs and walls. For load-bearing wood-based panels fitted on structural joists for decking in roof applications in load categories 'H' and 'I' (according to the National Annex to EN 1991-1-1 *Eurocode 1. Actions on structures. General actions. Densities, self-weight, imposed loads for buildings*), type testing of punching shear strength under concentrated loading shall be assessed according to EN 1195 *Timber structures. Test methods. Performance of structural floor decking* and Annex A of EN 12871. Type testing of resistance to vertical soft body impact shall be assessed according to EN 1195. Wood-based panels used for roofs in load category 'H' should conform with Impact Class II. Wood-based panels used for roofs in load category 'I' should conform with Impact Class I.

For load-bearing wood-based panels fitted on studs for walling applications (i.e., an abutment wall upstand (including parapets)), type testing of resistance to pendular soft body impact shall be assessed according to EN 596 *Timber structures. Test methods. Soft body impact test of timber framed walls.* Wood-based panels used for wall sheathing on studs should conform with Impact Class III.

Upon completion of all relevant testing, the suitability of a Cement-Bonded Particleboard for use as a structural roof deck (load category 'H' or 'I') or abutment wall upstand (including parapets) in a warm roof (service class 1) or cold roof (service class 2) should be determined by calculation, as outlined by Annex B of EN 12871. An example calculation is outlined by Annex C.

DEFINITIONS

- **Load Categories** Load category 'H' applies to roofs not accessible except for normal maintenance and repair. Load category 'I' applies to roofs accessible with occupancy according to categories A to D. Impact Classes I, II and III are defined in EN 12871 Tables 4, 5 and 6, respectively.
- **Warm Roof (service class 1)** EN 12871 defines a warm roof as a roof design in which the panels supported by the joists are placed below the insulation. Usually, the panels are considered to be under conditions corresponding to service class 1. According to EN 1995-1-1 Eurocode 5. Design of timber structures. General. Common rules and rules for buildings, service class 1 is characterised by a moisture content in the materials corresponding to a temperature of 20°C and the relative humidity of the surrounding air only exceeding 65% for a few weeks per year.
- **Cold Roof (service class 2)** EN 12871 defines a cold roof as a roof design in which the panels and some of the supporting joists are placed above the insulation. Usually, the panels are considered to be under conditions corresponding to service class 2. According to BS EN 1995-1-1, service class 2 is characterised by a moisture content in the materials corresponding to a temperature of 20°C and the relative humidity of the surrounding air only exceeding 85% for a few weeks per year.

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ETEX BUILDING PERFORMANCE LIMITED

Manufacturer of *Cementex* Fibre Cement and *Duripanel* Cement-Bonded Particleboard building boards.
Gordano House, Marsh Lane, Easton-in-Gordano, Bristol, BS20 0NE
www.etexgroup.com

EUROFORM PRODUCTS LTD

Manufacturer of *Versafloor* and *Versapanel* Cement-Bonded Particleboard building boards.
Unit 2, Lyncastle Road, Warrington WA4 4SN
www.euroform.co.uk

GEORGIA-PACIFIC GYPSUM LLC

Manufacturer of *DensDeck* and *DensDeck Prime* Gypsum building boards.
133 Peachtree Street NE, 8th Floor, Atlanta, GA 30303
densdeck.buildgp.com

KEMWELL FACADES LIMITED

Manufacturer of *KemFloor* and *WeatherKem* Fibre Cement building boards.
Unit 61, The Avenue, Rubery, Birmingham, B45 9AL
www.kemwell-fire.com

KNAUF

Manufacturer of *Aquapanel* Fibre Cement building boards.
Kemsley Fields Business Park, Kent, ME9 8SR
www.knauf.co.uk

MAGPLY ROOFING DIVISION

Manufacturer of *MagPly* Magnesium Oxide (Magnesium Oxysulfate) building boards.
IPP Ltd, Bradwell Hall, Bradwell-on-Sea, Essex, CM0 7HX
www.magply.co.uk

STS LTD

Manufacturer of *NoMorePly* and *STS Construction Board* Fibre Cement building boards.
STS Ltd, Ravens Park, Victoria Road, Leeds, LS14 2LA
www.sts-uk.com

All contact details are correct at the date of publication.

DISCLAIMER

The *Single Ply Roofing Association* (SPRA), *Liquid Roofing and Waterproofing Association* (LRWA), *National Federation of Roofing Contractors* (NFRC) and any contributors believe that the guidance and information contained in this document is correct at the date of publication. All parties must rely on their own skill and judgement when making use of it.

This guidance document is not exhaustive and building designers will be required to check constructions against guidance for a number of functional standards. It is recommended that project specifics are discussed with the local authority and a qualified fire engineer, particularly when following alternative guidance or a fire safety engineered approach.

National Building Regulations are intended to ensure a reasonable standard of life safety in a fire. The protection of property, including the building itself, often requires additional measures. Insurers usually set higher standards before accepting the insurance risk. Many insurers use the *RISCAuthority Design Guide for the Fire Protection of Buildings* by the *Fire Protection Association* (FPA) as a basis for providing guidance to the building designer on what they require. Further information on the protection of property can be obtained from the FPA website: www.thefpa.co.uk.

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