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PARTICIPATING ORGANISATIONS
The Foreword provides a list of organisations that participated in the preparation of this Standard which has also been reviewed by the BRE Global Impartiality Committee.

REVISION OF BRE PRODUCT STANDARDS
BRE Product Standards (BPSs) will be revised by issue of revised editions or amendments. Details will be posted on our website at https://www.bregroup.com/services/certification-and-listings.

Technical or other changes which affect the requirements for the approval or certification of the product or service will result in a new issue. Minor or administrative changes (e.g. corrections of spelling and typographical errors, changes to address and copyright details, the addition of notes for clarification etc.) may be made as amendments.

The issue number will be given in decimal format with the integer part giving the issue number and the fractional part giving the number of amendments (e.g. Issue 3.2 indicates that the document is at Issue 3 with 2 amendments).

USERS OF BRE PRODUCT STANDARDS SHOULD ENSURE THAT THEY POSSESS THE LATEST ISSUE AND ALL AMENDMENTS.
FOREWORD

This Standard identifies the evaluation and testing practices undertaken by BRE Global for the purposes of certification and listing of products. BRE Global certification and listing of products is based on evidence acceptable to BRE Global:-

- that the product meets the standard;
- that the manufacturer has staff, processes and systems in place to ensure that the product delivered meets the standard

and on:

- periodic audits of the manufacturer including testing as appropriate;
- compliance with the contract for BRE Global certification and listing including agreement to rectify faults as appropriate;

The responsibility for ensuring compliance with the technical and managerial process and requirements for the product or service lies with the manufacturer or supplier.

This BRE Product Standard (BPS) 7014 has been developed to provide a route to certification for modular systems for use in the construction of residential buildings.

This Standard sets out performance requirements in a number of technical areas. Some of the requirements are mandatory, such as for fire and structural performance, and are required to demonstrate regulatory compliance. Other performance assessments are voluntary. The requirements have been subject to detailed consultation with the Advanced Manufacturing of Homes Buildings and Infrastructure (AMHBI) project consortium and other stakeholders including:

- The Department of Business Innovation and Skills;
- English Partnerships and the Housing Corporation;
- Association of British Insurers (ABI) and insurers;
- Council of Mortgage Lenders (CML) [now UK Finance] and lenders;
- Designers;
- Manufacturers;
- Specifiers;
- Building Control (LABC);
- National House-Building Council (NHBC);
- BOPAS Buildoffsite;
- Robust Details Ltd.
Advanced Manufacturing of Homes, Buildings and Infrastructure (AMHBI)

AMHBI is part of the Advanced Manufacturing Supply Chain Initiative (AMSCI) ref 14005. The objective of AMHBI is to help address the capacity gap in housing through development of modular products and advanced manufacturing delivery processes. The preparation of this standard is a constituent part of this project to support customer confidence and adoption of modular and manufactured housing systems and products.

In addition, the AMSCI aims to move towards increased use of digital prototyping, testing and manufacturing quality control processes to support a validated digital model/prototype. For example, if a validated model is in place this could support lower requirement for physical testing.

It is designed to improve the global competitiveness of advanced manufacturing and supply chains. It supports research and development skills training and capital investment to help supply chains achieve World-class standards and encourage major new suppliers.

AMHBI Consortium and Partners:

<table>
<thead>
<tr>
<th>Laing O’Rourke PLC</th>
<th>Fulcro Engineering Services Ltd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airedale International Air Conditioning Ltd</td>
<td>Grundfos Pumps Ltd</td>
</tr>
<tr>
<td>Apex Cables Ltd</td>
<td>Hamworthy Heating Ltd</td>
</tr>
<tr>
<td>Armstrong Fluid Technology Ltd</td>
<td>Hoare Lea LLP</td>
</tr>
<tr>
<td>ARUP Associates Ltd</td>
<td>Select Plant Hire Ltd</td>
</tr>
<tr>
<td>Beckhoff Automation Ltd</td>
<td>SIG Distribution Ltd</td>
</tr>
<tr>
<td>Crown House Technologies Ltd</td>
<td>Thorn Lighting Ltd</td>
</tr>
<tr>
<td>Saint Gobain Construction Products (trading as BPB UK Ltd)</td>
<td>University of Cambridge (Centre for Manufacturing)</td>
</tr>
<tr>
<td>Building Research Establishment Limited</td>
<td>University of Sheffield (Advanced Manufacturing Centre)</td>
</tr>
<tr>
<td>Crane Ltd</td>
<td>WSP UK Ltd</td>
</tr>
<tr>
<td>Expanded Ltd</td>
<td>Explore Manufacturing Ltd</td>
</tr>
</tbody>
</table>

BRE is also grateful for the support of technical sub-committees. These were

Working Group 1: Structural (incorporating Security);
Working Group 2: Fire;
Working Group 3: Acoustic;
Working Group 4: Sustainability;
Working Group 5: Health & Wellbeing (including thermal performance);
The Standard

In places BPS 7014 refers to UK Building Regulations for safety and functionality, and a range of characteristics including buildability, durability, security, resilience, repairability, whole life performance, adaptability, and for the manufacturer to provide guidance on installation and maintenance.

In addition, building systems that exceed the requirements of building regulations, can be appropriately assessed so that the enhanced performance characteristics can be duly declared by the manufacturer.

Additional performance characteristics and their assessment methods are provided within the this Standard and refer to enhanced standards and assessment of module performance in 3D and user health and wellbeing issues.

It is recognised that the completed building will have to comply with additional regulatory requirements, this Standard focusses on the requirements for the individual elements and module.
GENERAL

The technical section identifies the requirements for the building system to meet and refers to the relevant regulations and standards given in Section 3 and other stakeholder requirements that were identified as part of the development process of this Standard.

The manufacturer shall demonstrate compliance with the requirements. This may be through calculation or via one of the following, as stated in each section:

- Classified without testing (for example, applies to some performance characteristics in fire or where Robust Details® are adopted)
- Classified without further testing declarations (applies to some performance in fire),
- Testing by laboratories having the relevant UKAS accreditation (or an equivalent accreditation body as recognised by the International Laboratory Accreditation Cooperation [ILAC] or International Accreditation Forum [IAF]). Alternatively, non-accredited testing may be accepted at the discretion of the Certification Body, where a laboratory can demonstrate testing has been conducted to the principles of ISO 17025.
- Assessment by visual inspection, or by appropriate product and/or process verification.
- Use of CE Marked products covered by Harmonised Technical Specifications under European Construction Products Regulations, or other third-party certificated components. Where available, EC Harmonised Technical Specifications shall be used, which can be found at: https://ec.europa.eu/growth/tools-databases/nando/index.cfm?fuseaction=cp.hs&cpr=Y#hs
- Any other means referenced within this Standard;

BPS 7014 also recognises performance of building systems tested to:

- **LPS 1501**: Fire test and performance requirements for innovative methods of building construction, the methodology of which is now incorporated within Annex B of this Standard.
- **LPS 1175**: Specification for testing and classifying the burglary resistance of building components, strongpoints and security enclosures.
- **LPS 2081**: Requirements and testing procedures for the LPCB approval and listing of building components, strongpoints, security enclosures and free-standing barriers offering resistance to intruders attempting to use stealth to gain entry.
- **BPS 7014 Method 1**: Three-dimensional structural assessment methodology
- **BPS 7014 Method 2**: Three-dimensional acoustic test methodology

The following non-life safety related performance characteristics are explicitly covered by BPS 7014:

**Sustainability** by voluntary performance declarations such as responsible sourcing and Environmental Product Declaration and comparison against some of BRE Global’s Home Quality Mark requirements.
Comfort and wellbeing by a mixture of mandatory and voluntary performance declarations in relation to energy conservation, overheating, ventilation and indoor environments

Building Information Modelling (BIM), a voluntary performance as addressed within BS EN ISO 12006 Parts 2 and 3, BS EN ISO 19650 Series and Uniclass 2015.

Resilience a mixture of mandatory and voluntary by review of repairability, whole-life performance and adaptability.

BPS 7014 is to be used in association with detailed site and configuration specific design procedures and site installation/quality control supervision. One output from the application of BPS 7014 will require site check lists identifying critical features of the building system requiring appropriate monitoring during installation and construction. Those site check lists are to be used by the constructor and organisations responsible for providing inspection services.

BRE Global construction products certification listing of products and services for construction www.bregloballistings.com is based on the following;

i. Satisfactory product performance during initial testing and audit testing by BRE Global
ii. Satisfactory product construction
iii. Satisfactory system installation
iv. Satisfactory manufacturing processes incorporated with a certified Factory Production Control process.
v. Satisfactory product or system service experience
vi. Satisfactory verification by BRE Global of the establishment and maintenance of the manufacturer’s or service provider’s quality management systems.

This standard shall be used in conjunction with BRE Global Scheme Document SD 212C.

This Standard will be reviewed regularly and kept up to date. Current editions are freely available from the BRE Global construction products certification and listings website https://www.bregroup.com/services/certification-and-listings. Comments of a technical or editorial nature on these Standards are always welcomed and should be addressed to the Technical Director, BRE Global.

The BRE Trust, a registered charity, owns BRE and BRE Global. BRE Global test, assess, certificate and list products and services within a number of sectors. Approved products appear in our listings at https://www.bregroup.com/services/certification-and-listing.

BRE Global can be contacted at, Garston, Herts, WD25 9XX. Tel: +44 (0) 333 321 8811, E-mail: enquiries@bregroup.com.

Compliance with this Standard does not of itself confer immunity from legal obligations. Users of this Standard should ensure that they possess the latest issue and all amendments.
1.0 SCOPE

This Standard specifies performance and verification requirements for modular building systems, to be used in UK residential construction, which are manufactured offsite in a factory. This standard can be applied to modular building systems and components as described below. The modular building systems are considered for use in new build residential as well as for application in the refurbishment of existing residential buildings.

This Standard considers a basic modular unit, and panels, which may or may not include internal, external finishes or building services. The modular unit typically comprises a complete or part dwelling, or bathroom/kitchen unit. It also considers multiple modular units that when brought together create a finished building.

It is recognised that a completed building will have to comply with additional requirements, linked to a specific building, its location, layout, design assumptions etc, to meet regulatory compliance which are not covered by this Standard. This Standard focuses only on the requirements for the individual elements and/ or assembled modules.

Site specific service installations, structures and features (including foundations) are outside the scope of this Standard, except where certain performance aspects of these features affect the superstructure, e.g. foundation level tolerances.

This Standard does not consider appliances covered by CE marking e.g. sanitation, hot water safety and efficiency, drainage and waste disposal, and heat producing appliances. Such appliances shall comply with Building Regulations as applicable.

Services such as Gas, Electric (including Mains intake), Drainage etc. located outside the building envelope are not included but consideration shall be made at the design stage to enable services to pass through the building envelope.

Site installed in-situ or beam and block concrete ground floors are outside the scope of this Standard, but a factory installed ground floor structure floor within a module is included.

**Internal services and finishes** are not included in this Standard, but consideration will need to be given to penetrations and fixings within walls, floors and roofs that are provided to accept internal services and finishes. A plantroom shell could be included within this Standard. Services such as heating and drainage pipes, ventilation ducting, cabling for electrics, data handling, services monitoring and security, are not referred to specifically in this Standard. However, their integration within the modular building and how they connect between modules will need to be considered, together with fire stopping, repair, maintenance and replacement requirements.

**Facades** are not assessed as part of this Standard. For the purposes of this Standard, only the planned integration and accommodation of the weathertightness layer of the modular building will be assessed for durability. As such the chosen façade solution(s) and associated fixings, penetrations and cavity barriers or any parts thereof are to be provided for review.
Table 1 – List of system-types covered by this Standard

<table>
<thead>
<tr>
<th><strong>Floor</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Floor</td>
<td>A floor located directly above (or in contact with) the ground – may include rising damp or soil gas protection, and thermal insulation.</td>
</tr>
<tr>
<td>Intermediate Floor</td>
<td>A floor that separates an upper and lower living space and may be a separating structural element between dwellings. In volumetric systems the separating structural element might consist of module ceiling and module floor component.</td>
</tr>
<tr>
<td>Floor over an open space</td>
<td>A floor located above an open area such as an under-croft, car park, alleyway or similar.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Wall</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Load Bearing Wall</td>
<td>An internal or external load bearing wall. This may include a party wall.</td>
</tr>
<tr>
<td>Infill Wall</td>
<td>Wall that is built into the primary structural components of a building and can provide support for the cladding system. Infill walls are considered to be non-load bearing, but they resist transportation, lifting and wind loads, and also support their own weight and that of a cladding. This may include a party wall.</td>
</tr>
<tr>
<td>Facade</td>
<td>An external load bearing or non-load bearing cladding or walling system that provides weathertightness or rain-screening, and physical security when incorporated in the design</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Roof</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat Roof</td>
<td>Structure and covering to a flat roof and its connection to the module.</td>
</tr>
<tr>
<td>Pitched Roof</td>
<td>Structure and covering to a sloping roof and its connection to the module</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Unit</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel</td>
<td>Two-dimensional elements produced in a factory or on site used to form a three-dimensional (volumetric) module</td>
</tr>
<tr>
<td>Volumetric Module</td>
<td>A module or a part-module featuring interconnecting elements i.e. junction between two walls and a floor, or the junction between a roof and two walls.</td>
</tr>
<tr>
<td>Multiple Modules</td>
<td>Any assembly of connected volumetric modules. Modules manufactured in the same location, combined to form a functional part of a building (i.e. flat, room, corridor, staircase) and assessed in factory (offsite). Internal and/ or external finishes are either fitted in a factory or on site.</td>
</tr>
</tbody>
</table>

Note. Roofs can double as access areas.
This Figure shows examples of some of the system-types from Table 1 above

This is not exhaustive – for example infill walls and load bearing walls may be internal and not part of the external envelope.
This Standard makes reference to requirements of the UK Building Regulations and the Basic Works Requirements of the Construction Products Regulations 305-2011 (CPR) https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011R0305&from=EN :

- Mechanical resistance and stability
- Safety in case of Fire
- Hygiene, health and environment
- Safety and accessibility in use
- Protection against noise
- Energy economy and heat retention
- Sustainable use of natural resources

Requirements included for supply chain, off-site and on-site activities are:

- Design Life and service life planning
- Practicability of installation and buildability
- Practicability of repair and adaptability
- Unique identification of building systems
- Durability, materials and workmanship
- Factory production control
- Handling, lifting, transportation and storage
- Checklist for on-site construction
- Building information modelling (BIM)

**Normative References**

This Standard incorporates provisions from other publications. These references are cited at the appropriate places in the text and are listed in Section 5. For dated references, subsequent amendments to, or revisions of, any of these publications apply to this Standard only when incorporated into it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).
**BPS 7014 overview matrix**

The table below overviews all the requirements covered in this Standard and includes the reference as to where in the standard these are covered. Mandatory performance declarations [minimum requirements for demonstrating performance with the Standard] are marked in blue. Additional voluntary performance declarations are marked in green. N/A denotes not applicable.

**Table 2 – Overview of applicable requirements relative to system-type**

<table>
<thead>
<tr>
<th>SYSTEM-TYPE</th>
<th>FLOOR</th>
<th>WALL</th>
<th>ROOF</th>
<th>MODULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirements</td>
<td>Ground floor</td>
<td>Intermediate</td>
<td>Over open space</td>
<td>Load-bearing</td>
</tr>
<tr>
<td>3.1 Mechanical resistance and stability</td>
<td>3.1.1.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walls</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floors</td>
<td>3.1.3.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roofs</td>
<td></td>
<td></td>
<td>3.1.3.4</td>
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</tr>
<tr>
<td>Systems</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>3.2 Safety in case of fire</td>
<td>3.2.3.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistance to fire</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reaction to fire</td>
<td>3.2.3.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External fire spread</td>
<td>N/A</td>
<td></td>
<td>3.2.3.3</td>
<td></td>
</tr>
<tr>
<td>Whole module</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.3 Hygiene, health and environment</td>
<td>3.3.1.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weathertightness and airtightness</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Vapour permeability and moisture resistance</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Soil gases</td>
<td>3.3.1.3</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Ventilation</td>
<td></td>
<td></td>
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<tr>
<td>Overheating</td>
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<td></td>
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<tr>
<td>Dangerous substances</td>
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<tr>
<td>Electric lighting</td>
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<tr>
<td>3.4 Safety in use</td>
<td>3.4.1</td>
<td></td>
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<tr>
<td>Safety in use</td>
<td></td>
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</table>

Continued…
<table>
<thead>
<tr>
<th>SYSTEM-TYPE</th>
<th>FLOOR</th>
<th>WALL</th>
<th>ROOF</th>
<th>MODULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirements</td>
<td>Ground floor</td>
<td>Intermediate</td>
<td>Over open space</td>
<td>Load-bearing</td>
</tr>
<tr>
<td>3.5 Protection against noise</td>
<td>Protection against noise</td>
<td>3.5.1</td>
<td>3.5.1</td>
<td>3.5.9</td>
</tr>
<tr>
<td>3.6 Energy economy and heat retention</td>
<td>Energy economy and heat retention</td>
<td>3.6.1</td>
<td>3.6.1</td>
<td>3.6.1</td>
</tr>
<tr>
<td>3.7 Security</td>
<td>Security</td>
<td>3.7.1</td>
<td>3.7.1</td>
<td>3.7.1</td>
</tr>
<tr>
<td>3.8 Design change and service life planning</td>
<td>Design life planning</td>
<td>3.8.1</td>
<td>3.8.1</td>
<td>3.8.2</td>
</tr>
<tr>
<td>3.9 Durability resilience, materials and workmanship</td>
<td>Durability resilience, materials and workmanship</td>
<td>3.9.1</td>
<td>3.9.1</td>
<td>3.9.1</td>
</tr>
<tr>
<td>3.10 Sustainable use of natural resources</td>
<td>Environmental impact</td>
<td>3.10.1</td>
<td>3.10.1</td>
<td>3.10.1</td>
</tr>
<tr>
<td></td>
<td>Life cycle costing</td>
<td>3.10.2</td>
<td>3.10.2</td>
<td>3.10.2</td>
</tr>
<tr>
<td></td>
<td>Responsible sourcing</td>
<td>3.10.3</td>
<td>3.10.3</td>
<td>3.10.3</td>
</tr>
<tr>
<td>4.0 Quality Management Requirements</td>
<td>Practicability of installation</td>
<td>4.1</td>
<td>4.1</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td>Practicability of repair, replacement and adaptability</td>
<td>4.2</td>
<td>4.2</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>Identification of building systems</td>
<td>4.3</td>
<td>4.3</td>
<td>4.3</td>
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<tr>
<td></td>
<td>Factory Production Control</td>
<td>4.4</td>
<td>4.4</td>
<td>4.4</td>
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<td></td>
<td>Handling and storage</td>
<td>4.5</td>
<td>4.5</td>
<td>4.5</td>
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<tr>
<td></td>
<td>Site assembly</td>
<td>4.6</td>
<td>4.6</td>
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<td></td>
<td>Home information</td>
<td>4.7</td>
<td>4.7</td>
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<td></td>
<td>Building Information Modelling</td>
<td>4.8</td>
<td>4.8</td>
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</tr>
</tbody>
</table>
2 DEFINITIONS
The definition of terms used in this Standard shall be that given in the British Standard BS 6100 series: Glossary of building and civil engineering terms. Where the meaning of any term requires clarification or modification for use within this document then a definition is given in this section.

2.1 Applicant
The manufacturer or supplier of the building system seeking certification.

2.2 Assessment
An assessment is an opinion from a trained assessor of the likely performance of an element or component if it were subjected to a standard test. It shall only be used:
- where a modification is made to a construction which has already been tested;
- to interpolate results of a series of tests to evaluate a range of variables in a construction design or product; or
- where for reasons of size, or configuration, it is not possible to subject a construction to a test.
- wherever possible to assess a material, product or system the relevant standard for extended application will be followed. Where this is not possible the assessment will be guided by the principles established in Approved Document B: Fire Safety Appendix B: Performance of materials, products and structures and where no specific extended application standard exists assessment will follow the principles of BS EN 15725 Extended application reports on the fire performance of construction products and building elements [2010] will be adhered to.

2.3 Cavity barrier
A construction other than a smoke curtain, provided to close a concealed space against the penetration of smoke or flame, or provided to restrict the movement of smoke or flame within such a space.

2.4 Certification Body
BRE Global Ltd or its Licensees. This could also be operators of other industry certification schemes such as BOPAS.

2.5 Compartment
A building or part of a building, comprising one or more rooms, spaces or storeys, constructed to prevent the spread of fire to, or from, another part of the same building or an adjoining building.

2.6 Compartment wall or floor
A fire-resisting wall, or floor, that is used in the separation of one compartment from another to meet the specific requirements of the Building Regulations/Standards.

2.7 Component
A product manufactured as a distinct unit to serve a specific function or functions e.g., door, window, or frame connectors.
2.8 Design climatic conditions
Outdoor and indoor conditions (such as snow and wind loading, air temperature, relative humidity etc) as stated in the UK Building Regulations and/or other standards such as CIBSE Guide A: Environmental Design to be used for building design.

2.9 Dwelling
Dwelling includes a dwellinghouse and a flat. A dwelling is a unit where one or more people live (whether or not as a sole or main residence) in either of the following situations.
- A single person or people living together as a family.
- A maximum of six people living together as a single household, including where care is provided for residents.
A Dwellinghouse does not include a flat or a building containing a flat.
A Flat is defined in clause 2.16.

2.10 Durability
The ability of a building system, component or element to perform its intended function over a period of time.

2.11 Easily accessible element
An element, any part of which is within 2 metres vertically of an accessible level surface such as a ground or basement level, or an access balcony, or;
An element within 2 metres vertically of a flat roof or sloping roof (with a pitch of less than 30˚) that is within 3.5 metres of ground level.

2.12 Element of structure
A member forming part of the structural frame of a building, or any other beam or column. A loadbearing wall or loadbearing part of a wall. A floor. An external wall. A compartment wall (including a wall that is common to two or more buildings).

2.13 Façade
An external load bearing or non-load bearing cladding or walling system that provides weathertightness or rain-screening.

2.14 Fire stopping
A material provided to maintain efficacy and fire performance of joints in fire resisting elements. Proprietary, tested fire-stopping systems are sometimes referred to as fire sealing systems.

2.15 Fitness for Purpose
The ability of a building system, component or element to perform its function in its intended application.

2.16 Flat
A separate and self-contained premise constructed or adapted for use for residential purposes and forming part of a building from some other part of which is divided horizontally.
2.17 Flooding
The entry of water into a building or part of a building that could result in damage to the contents and/or structure. For this standard, levels of water temporarily up to 10cm below a damp-proof course or membrane are not classified as a flood, but levels above this are.

2.18 Health and Safety File
Documentation provided by the relevant building system defining how its health and safety requirements are fulfilled. The Construction Design and Management Regulations require a Health and Safety File to be prepared and handed over to the Client. See also Building Regulation 38: Fire safety information, passed from the person undertaking building works to the building owner on or before completion of building works. The information will enable the building owner to understand the fire safety features in the building and how to operate and maintain them.

2.19 Installation Manual
Documentation provided by the relevant building system defining how it shall be installed by a competent installer to fulfil its function.

2.20 Institution
An institution (whether described as a hospital, home, school or other similar establishment) which is used as living accommodation for, or for the treatment, care or maintenance of persons -
(a) suffering from disabilities due to illness or old age or other physical or mental incapacity, or
(b) under the age of five years, where such persons sleep on the premises.

2.21 Internal floor
Any floor within a building.

2.22 Internal partitions
Internal vertical construction which can be load bearing or non-load bearing.

2.23 Internal wall
Any wall inside a building.

2.24 Joint
The junction between two materials, components and elements, or parts of a building.

2.25 Load bearing element
Component bearing the weight that is carried by a structure, can include structural framing, walling, flooring or roof elements.

2.26 Modular Building System
Volumetric: Three-dimensional units produced in a factory, that may or may not be at a substantial level of internal completion, before being transported to site and stacked onto prepared foundations to form buildings
Panelised: Two dimensional units produced in a factory used to form three-dimensional units in a factory or on site.
2.27 Overheating
This describes when temperature conditions in a building reach a level that may cause occupants to feel uncomfortable or heat stressed.

2.28 Repairability
The ability of a component or element to be repaired (unplanned replacement) following damage or failure or, replaced (planned replacement), considering the accessibility, ease and duration of the repair process.

2.29 Robustness
Ability of a system to resist damage resulting from accidental or natural events.

2.30 Rooms for residential purposes
A room, or a suite of rooms, which is not a dwelling-house or a flat and which is used by one or more persons to live and sleep and includes a room in a hostel, an hotel, a boarding house, a hall of residence or a residential home, but does not include a room in a hospital, or other similar establishment, used for patient accommodation.

2.31 Separating floor
A compartment floor that separates compartments and construction to enclose a protected escape route or place of special fire hazard.

2.32 Separating wall
A compartment wall that separates compartments and or construction to enclose a protected escape route or place of special fire hazard. Can also include a cavity barrier.

2.33 Site Assembly Checklist
This is issued in conjunction with a set of clear instructions (provided by the manufacturer) which details the assembly and installation of the system as appropriate. The checklist details the installation check criteria for critical parts of the assembly and critical aspects of its relationship with other parts of the construction. The checklist includes specifications, tolerances and order of construction of integrated conventional construction and any other appropriate information needed to ensure that on site construction of each module meets the standards certified under this Standard.

2.34 Unit
A unit is formed of elements and components, either panellised or volumetric.

2.35 User Manual
A document provided by the Manufacturer to enable the end user to run their building effectively. It shall describe the building system, including thermal performance characteristics, and the ‘Dos and Don’ts’ that need to be understood before any maintenance, or adaptation, of the system is undertaken. The User Manual shall form part of the building's Health and Safety File.

2.36 Ventilation
The supply and removal of air (by natural and or mechanical means) to and from a space or spaces in a building. Normally achieved by both background infiltration and purge ventilation.
2.37 Weather tightness
Performance in respect of air permeability, water tightness and wind resistance.
3 REQUIREMENTS

3.1 MECHANICAL RESISTANCE AND STABILITY

3.1.1 Requirements

3.1.1.1 The system shall meet the Building Regulation requirements in England, Wales, Scotland and Northern Ireland, for mechanical resistance and stability in construction.

3.1.1.2 The design shall

a) identify hazards to which the structure is likely to be subjected, assessment of the risks and select relevant critical situations that can reasonably be foreseen.

b) determine dead load, imposed and accidental loads using current Codes of Practice (see Section 5), including BS EN 1991-1-1, BS 1991-1-3, BS EN 1991-1-5 and BS EN 1991-1-7.

c) determine wind loads using BS EN 1991-1-4 taking appropriate account of location-related effects. Wind loads may be calculated either for specific locations or based on a stipulated maximum value which may then limit the locations where the building can be sited in the UK.

d) confirm the façade solution(s) to be used in conjunction with the system and any key components such as fixings.

e) explicitly consider loads during execution using BS EN 1991-1-6 and temporary loading cases (during transport and construction) shall be considered explicitly in the design.

3.1.2 Verification by Calculation

3.1.2.1 The design of systems shall be carried out in accordance with relevant structural design standards. Where this is not possible owing to the absence of appropriate standards, then the design shall be carried out by a qualified structural engineer based on sound engineering principles supported by appropriate technical data.

3.1.3 Verification by Testing

3.1.3.1 Where testing is used to demonstrate compliance of systems (including full module testing), elements and components it shall be done in accordance with the appropriate section of relevant material, product, test and structural design standards (or closest aligned standard) and BS EN 1990 shall be used.

3.1.3.2 The manufacturer shall determine the performance of load bearing walls including but not limited to:

a) Vertical load bearing resistance (including eccentric loading where relevant)

b) Racking resistance

c) Horizontal load bearing resistance

d) Soft and hard body impact resistance
3.1.3.3 The manufacturer shall determine the performance of load bearing floors for specified maximum spans, including but not limited to
a) Resistance to uniformly distributed vertical load
b) Resistance to concentrated vertical load
c) Resistance to horizontal shear action (diaphragm)
d) Soft and hard body impact resistance
e) Natural frequency
f) Modal Mass
g) Damping
h) Response factor

3.1.3.4 The manufacturer shall determine the performance of roofs for specified maximum spans, including but not limited to
a) Resistance to uniformly distributed vertical load
b) Resistance to concentrated vertical load
c) Soft and hard body impact resistance

3.1.3.5 The manufacturer should demonstrate the building system has adequate levels of robustness and shall demonstrate the building will not suffer collapse to an extent disproportionate to the cause.

3.2 SAFETY IN CASE OF FIRE

3.2.1 Requirements
3.2.1.1 3.2.1.1 The system shall meet the Building Regulation requirements in England, Wales, Scotland and Northern Ireland, for fire safety in construction.

3.2.2 Verification by Calculation
3.2.2.1 This may be used where permitted.

3.2.3 Verification by Testing/Assessment
3.2.3.1 Fire resistance

3.2.3.1.1 Where compartmentation is provided (using fire separating walls and floors) joints, imperfections of fit and openings for pipes ducts, flues and services to pass, must be adequately protected by fire stopping. The manufacturer shall design the fire resistance of the separating element in accordance with:
- Results of testing in accordance with the European fire resistance classification through BS EN 13501-2 employing the relevant EN test methods.

3.2.3.1.2 Where a compartment wall or a compartment floor meets another compartment wall, or an external wall, or where an internal cavity wall meets a compartment wall or compartment floor or other wall (or door assembly) forming a fire resisting barrier, the manufacturer shall design that junction to incorporate appropriate cavity barriers.
3.2.3.1.3 The minimum fire resistance for compartment walls, floors and roofs shall be as required to meet Building Regulations in respect to its use and shall be expressed in terms of Load bearing Capacity (R), Integrity (E) and Insulation (I). For Building Regulations (England) refer to Appendix B Tables B3 and B4 of Approved Document B.

3.2.3.1.4 Cavity barriers shall be fitted to close cavities around openings, prevent unseen spread of fire and smoke and make floor wall and roof cavities discontinuous. In all instances, the requirements for the placing of cavity barriers and fire stopping shall follow the guidance given in Approved Document: Fire Safety B3: Internal fire spread (Structural) (England), AD B1 (Wales), the Technical Handbooks 2.4 (Scotland) and the Technical Booklet E (N.I.)

3.2.3.2 Reaction to fire

3.2.3.2.1 The manufacturer shall satisfy the Building Regulations requirements for Reaction to Fire performance by using construction products classified in accordance with BS EN 13501-1 and taking due consideration of the field of application to ensure that the required classification is achieved in practice.

3.2.3.3 External fire spread on walls and roofs

3.2.3.3.1 The manufacturer shall satisfy the Building Regulations requirements for external fire spread performance by using external roof systems classified in accordance with BS EN 13501 Part 5 for roofing using test method 4.

3.2.3.3.2 To satisfy the Building Regulations requirements for England, any building with a storey (but not roof-top plant areas or any story consisting exclusively of plant rooms) at least 18m above ground level and which contains:
- one or more dwellings; or an institution; or a room for residential purposes (excluding any room in a hostel, hotel or a boarding house).
This includes residential blocks of flats, student accommodations, care homes, sheltered housing, hospitals and dormitories in boarding schools with a storey above 18 m in height.

All materials which become part of an external wall or specified attachment shall achieve European Class A2-s1, d0 or Class A1 except for components exempted in Regulation 7(3).

Additionally, cavity barriers shall be fitted in the external wall systems. These shall be tested and classified to provide at least 30 minutes fire resistance and meet the guidance given in section 9 – Concealed spaces (cavities) of Approved Document B, Volume 2 which includes around openings (see diagram 33).

3.2.3.4 Fire test on whole module(s)

3.2.3.4.1 When tested in accordance with Annex B of this Standard the module shall achieve a classification of MMC2 as defined in Annex B of this Standard.
3.3 HYGIENE, HEALTH AND ENVIRONMENT

3.3.1 Requirements
The system shall meet the Building Regulation requirements in England, Wales, Scotland and Northern Ireland, for hygiene, health and environment in construction.

3.3.1.1 Weathertightness and airtightness

3.3.1.1.1 Verification by Desk Study
The external envelope shall be weathertight, and the manufacturer shall submit construction details to demonstrate this. The manufacturer shall place emphasis on the full external envelope, including joints between prefabricated components in the external facade and connections between that facade and its supporting structure.

3.3.1.1.2 Verification by Testing
3.3.1.1.2.1 The external envelope shall be weathertight, and evidence as demonstrated by testing, for example to CWCT Technical Note TN 41, shall be provided by the manufacturer. The manufacturer shall consider testing of a whole wall or module complete with doors and windows as testing of individual components does not address the joints between components within a whole system.

3.3.1.1.2.2 Airtightness testing to satisfy building regulations is carried out on whole dwellings in accordance with ATTMA requirements TS L1. This can be at shell and core stage or on completion and shall address the joints between individual components such as windows and doors.

3.3.1.2 Vapour permeability and moisture resistance

3.3.1.2.1 Verification by Desk Study and Site Visit
3.3.1.2.1.1 The manufacturer shall determine the risk of interstitial condensation for each element (as required) in accordance with BS EN ISO 13788 and BS 5250.

3.3.1.2.1.2 The water-tightness of any basement construction and its elements shall be designed to comply with BS 8102 and the Approved Document for basements in dwellings.

3.3.1.2.2 Verification by Testing
The manufacturer shall demonstrate vapour permeability and moisture resistance through results of testing carried out to BS EN 12086 or other relevant standards.

3.3.1.3 Protection against soil gases

3.3.1.3.1 Verification by Desk Study
The manufacturer shall demonstrate how the dwelling is to be protected from the risk from soil gases in accordance with BS 8485 and BRE Report BR 211, in cases of sites where such a risk is identified.
3.3.1.4 Ventilation

3.3.1.4.1 Verification by Desk Study

The manufacturer shall provide all relevant information regarding the module’s ventilation systems, which will go into the user manual (see section 4.7 of BPS 7014). Note that ventilation is considered at the whole dwelling level.

Information must be provided for the intended user for the ventilation system installed, including:

- The commissioning certificate
- User instructions for the system and controls
- A user-friendly description and explanation of the system (including the location of components)
- Details of routine maintenance
- Method of cleaning ductwork (where required)
- Guidance for the use of summer bypass and boost settings (where installed)
- Contact details for the manufacturer and installer
- Details of the installed system, including part numbers
- Details of any maintenance and service agreements

The manufacturer shall provide an assessment to demonstrate purge ventilation capability and impact on the noise environment.

3.3.1.4.2 Verification by Testing

The manufacturer shall test the system in accordance with Approved Document (AD) F to demonstrate that the ventilation rates are in accordance with the requirements of AD F and/or corresponding Regulations for Scotland, Wales and Northern Ireland.

Additionally, the manufacturer may wish to demonstrate compliance with the table below (this is considered as beyond the minimum requirement in AD F).

**Ventilation rates**

<table>
<thead>
<tr>
<th>Number of bedrooms</th>
<th>Assumed maximum occupancy</th>
<th>Minimum ventilation rate (l/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>29</td>
</tr>
<tr>
<td>4+</td>
<td>8 + 2 additional occupants per additional bedroom</td>
<td>37 + 8L/s per additional bedroom</td>
</tr>
</tbody>
</table>
3.3.1.5 Overheating

3.3.1.5.1 Verification by Desk Study

The manufacturer of a fully fitted out module shall provide a generic assessment of the risk of overheating and how the risk is to be minimised. Guidance is provided by the Home Quality Mark (HQM) Temperature Tool and CIBSE TM59.

Aspects to consider (not exhaustive) include:

- Solar shading and shutters
- Cooling and ventilation strategies
- Heat-reflective finishes
- Orientation
- Window design
- Occupant guidance

3.3.1.6 Dangerous substances (within or released from construction materials)

3.3.1.6.1 Verification by Desk Study

The manufacturer shall minimise detrimental impacts on health arising from indoor air pollutants emitted from the building at the time of habitation by using materials that do not contain or release dangerous substances.

For information, Annex I to the Dangerous Substances Directive 67/548/EEC contains a list of some 8000 dangerous substances for which classification and labelling have been agreed at Community level.

3.3.1.6.2 Verification by Testing

When tested in accordance with BS EN ISO 16000-6 or BS EN ISO 16017-2 the airborne Total Volatile Organic Compounds (TVOC) from all sources (where the TVOC concentration in indoor air is measured post construction, but pre-occupancy) shall not exceed 0.3mg/m³ (300μg/m³), averaged over 8 hours.

When tested in accordance with the Table below the emissions from building product types shall not exceed the emissions limits listed in the Table below.

**Emission limits (maximum)**

<table>
<thead>
<tr>
<th>Building Product type</th>
<th>Emission limits</th>
<th>Total Volatile organic compounds (TVOCs)</th>
<th>Category 1A and 1B carcinogens*</th>
<th>Testing requirement</th>
<th>Additional requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior paints and varnishes</td>
<td>0.06 mg/m³</td>
<td>1.0 mg/m³</td>
<td>0.001 mg/m³</td>
<td>BS EN 16402 or BS EN ISO 16000-9 or PD CEN 16516 or CDPH Standard Method v11</td>
<td>Paints used in wet areas (e.g. bathrooms, kitchens, utility rooms) should protect against mould growth</td>
</tr>
<tr>
<td>Wood-based products (Non MDF)</td>
<td>0.06 mg/m³</td>
<td>1.0 mg/m³</td>
<td>0.001 mg/m³</td>
<td>BS EN ISO 16000-9 or PD CEN 16516</td>
<td>N/A</td>
</tr>
<tr>
<td>Issue: 1.0</td>
<td>BRE PRODUCT STANDARD</td>
<td>BPS 7014</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>January 2021</td>
<td>Standard for Modular Systems for Dwellings</td>
<td>Page 25 of 64</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Emissions Rate</th>
<th>Emissions Rate</th>
<th>Formaldehyde Emissions Rate</th>
<th>Standard or Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flooring materials</strong></td>
<td>0.08 mg/m³ (MDF)</td>
<td>0.001 mg/m³</td>
<td>BS EN ISO 16000-9 or PD CEN 16516 or CDPH Standard Method v11</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Ceiling, wall and insulation materials</strong></td>
<td>0.06 mg/m³</td>
<td>0.001 mg/m³</td>
<td>BS EN ISO 16000-9 or PD CEN 16516 or CDPH Standard Method v11</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Interior adhesives and sealants</strong></td>
<td>0.06 mg/m³</td>
<td>0.001 mg/m³</td>
<td>BS EN 13999 (pts 1-4) or BS EN ISO 16000-9 or PD CEN 16516 or CDPH Standard Method v11</td>
<td>N/A</td>
</tr>
</tbody>
</table>

*Emissions testing to the methods referenced in column 5 of the table normally provides an Emissions Rate per area of the material (in, for example, units µg/m²/hr). Because the actual concentration of an emitted compound in room air in the modular building will depend on several factors (surface area of the emitting material; volume of room; air change rate of room) the emissions rate can be converted to a theoretical concentration once the dimensions of the space, area of product to be used and ventilation strategy are known.

### 3.3.1.7 Electric lighting

#### 3.3.1.7.1 Verification by Desk Study

Electric lighting (luminaires and switches) shall be CE marked which indicates compliance with safety standards and electromagnetic compatibility. The lighting installation must comply with the IET Wiring Regulations (currently BS 7671:2018).

Where possible, dimming of internal lighting, rather than just switching, should be provided to give residents a wider range of lighting choices and to generally provide energy savings compared to switching alone.
3.4 SAFETY IN USE

3.4.1 Requirements

The system shall meet the Building Regulation requirements in England, Wales, Scotland and Northern Ireland, for safety in use in construction.

3.4.1.1 Verification by Calculation/Inspection

3.4.1.1.1 The manufacturer shall determine the design loads appropriate to occupancy and use from BS EN 1991-1-1. The design of elements and components shall either be in accordance with the relevant material and performance standards e.g. BS 6180 for barriers, BS 585 and/or BS 5395 for stairs, or based on established product performance for that use. For the latter, the manufacturer shall supply relevant product data.

3.4.1.1.2 Where appropriate, the manufacturer shall design appropriate provision for reasonable access for wheelchair users and ambulant disabled people to and from the building and for their movement within the building in accordance with BS 8300 and Approved Document M Category 2 provision.

3.4.1.2 Verification by Testing

3.4.1.2.1 Where established product performance is not available then the manufacturer shall provide test data appropriate to the function of the elements or components in use.

3.4.1.2.2 Communal areas inside multi-residential buildings are required to use emergency lighting. Relevant emergency lighting recommendations are given in BS 5266-1, BS EN 1838, BS EN 50172 and CIBSE LG12.
3.5 PROTECTION AGAINST NOISE

3.5.1 Requirements

3.5.1.1 The system shall meet the Building Regulation requirements in England, Wales, Scotland and Northern Ireland, for protection against noise in construction.

<table>
<thead>
<tr>
<th>England</th>
<th>Wales</th>
<th>Scotland</th>
<th>Northern Ireland</th>
<th>System Type</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>E1</td>
<td>Standard 5.1</td>
<td>Regulation 49</td>
<td>Intermediate Floors; Floor over an open space; Load bearing wall; Infill Wall; Three-dimensional module; Multiple modules</td>
<td>Where they form separating walls and/or floors</td>
</tr>
<tr>
<td>E2</td>
<td>E2</td>
<td>Standard 5.2</td>
<td>Regulation 50</td>
<td>Intermediate Floor; Infill Wall</td>
<td>Where they are used as internal walls or internal floors</td>
</tr>
</tbody>
</table>

3.5.2 Verification by calculation – Separating walls and/or floors

3.5.2.1 Not applicable

3.5.3 Verification by testing – Separating walls and/or floors

3.5.3.1 The developer/manufacturer is required to demonstrate compliance for Building Control Purposes on a site-by-site basis through on-site performance testing between completed, or near completed, pairs of dwellings or rooms for residential purposes in accordance with the relevant National Requirements.

3.5.3.2 Airborne sound insulation performance for separating walls and separating floors shall be presented in the following single figure ratings:

\[ D_{nT,w} \text{ (dB)} \] and \[ D_{nT,w+C_{tr}} \text{ (dB)} \]

3.5.3.3 Airborne sound insulation performance for separating walls and separating floors shall be presented in one-third octave bands between 100 Hz and 3150 Hz in:

\[ D_{nT} \text{ (dB)} \]

3.5.3.4 Impact sound insulation performance for separating walls and separating floors shall be presented in the following single figure ratings:

\[ L'_{nT,w} \text{ (dB)} \]
3.5.3.5 Impact sound insulation performance for separating floors shall be presented in one-third octave bands between 100 Hz and 3150 Hz in:

\[ L'_{IT} \text{ (dB)} \]

3.5.3.6 Comparison of measured performance shall be presented against relevant, National performance targets.

3.5.3.7 Alternatively, the system shall be approved for use in the Robust Details® Handbook and the plots registered and built in accordance with the Robust Details scheme requirements, in which case on-site performance testing is not required.

3.5.3.8 Where on-site test evidence from a previous development is available, this should be submitted as evidence to meet the requirements of this Standard. While this evidence will not be sufficient to discharge obligations under the relevant National Regulations, it will help to quantify potential performance of the system to inform decision makers over the potential suitablility of the system.

3.5.3.9 Where a system has not been tested on-site and is not approved for use in the Robust Details Handbook, then testing and reporting in accordance with Annex A.1 is required to meet the requirements of this Standard. While this evidence will not be sufficient to discharge obligations under the relevant National Regulations, it will help to quantify potential performance of the system to inform decision makers over the potential suitability of the system.

3.5.3.10 Where system tests are conducted in accordance with Annex A.1, the three-dimensional testing shall be conducted if the modular building system comprises multiple elements. Where the system only comprises a single element, the two-dimensional testing shall be undertaken.

**3.5.4 Verification by calculation – Internal walls and/or floors**

3.5.4.1 Not applicable

**3.5.5 Verification by testing – Internal walls and/or floors**

3.5.5.1 The developer/manufacturer is required to demonstrate compliance for Building Control purposes on a site-by-site basis through submission of the results from laboratory testing in accordance with the relevant National Requirements.

3.5.5.2 Performance of internal walls and floors is established through two-dimensional testing in an acoustic laboratory, in accordance with BS EN ISO 10140-1 and BS EN ISO 10140-2. See Annex A.1 for additional information.

3.5.5.3 Airborne sound insulation performance for internal walls and internal floors shall be presented in in the following single figure rating:

\[ R_w \text{ (dB)} \]

3.5.5.4 Airborne sound insulation performance for internal walls and internal floors shall be
presented in one-third octave bands between 100 Hz and 3150 Hz in:
\[ R \text{ (dB)} \]

3.5.5.5 Comparison of measured performance shall be presented against relevant, National performance targets.

3.5.5.6 The tested specimen representative of the internal wall or floor should not include any penetrations, electrical sockets, electrical switches or deflection head details.

**3.5.6 Verification by calculation – corridors, hallways, stairwells and entrance halls that give access to flats and rooms for residential purposes**

3.5.6.1 The developer/manufacturer is required to demonstrate compliance for Building Control Purposes on a site-by-site basis through calculation in accordance with the relevant National Requirements.

3.5.6.2 Calculations shall be conducted in accordance with Method A or Method B as described in the relevant National Guidance (see Approved Document E for England and Wales, Technical Booklet G for Northern Ireland).

3.5.6.3 Existing published data may be used for ascribing absorptive performance to surfaces for the purposes of the calculations. Where data is not available for specific surfaces, materials or treatment then sound absorption testing shall be undertaken in accordance with BS EN ISO 20354 by a UKAS accredited testing laboratory with the results rated in accordance with BS EN ISO 11654.

3.5.6.4 The report format shall include:

a) a description of the enclosed space (entrance hall, corridor, stairwell, etc.);

b) the approach used to satisfy the requirements, Method A or B

i. with Method A, state the absorber class and the area to be covered; or

ii. with Method B, state the total absorption area of additional absorptive material used to satisfy the requirement; and

c) Plans indicating the assignment of the absorptive material in the enclosed space.

d) Sound absorption data used in the calculation, including test reports (or relevant extracts) demonstrating performance.

3.5.6.5 Depending on the system design, it may be that Method B demonstrates that additional absorbent materials are not required to satisfy the requirements beyond the developed system.

3.5.6.6 Where additional sound absorptive material(s) which are not part of the system need to be incorporated to satisfy the requirements, they shall be clearly identified in terms of manufacturer and system/product identification.
3.5.7 Verification by testing – corridors, hallways, stairwells and entrance halls that give access to flats and rooms for residential purposes

3.5.7.1 Not applicable

3.5.8 Additional performance declaration (non-Building Regulations) (APD)

3.5.8.1 Several noise related issues are covered by this Standard which are not currently addressed by UK Building Regulations. These issues are detailed below with system types and evidence requirements:

<table>
<thead>
<tr>
<th>Description</th>
<th>System Types</th>
<th>Performance to be declared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Envelope</td>
<td>Infill wall (where used as an external wall)</td>
<td><strong>Airborne sound insulation</strong></td>
</tr>
<tr>
<td></td>
<td>Façade</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flat roof</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pitched roof</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Three-dimensional module (where forming aspects of the building envelope)</td>
<td></td>
</tr>
<tr>
<td>Building Envelope</td>
<td>Flat roof (where forming an amenity area/roof terrace)</td>
<td><strong>Impact sound insulation</strong></td>
</tr>
<tr>
<td>Building Envelope</td>
<td>Flat roof</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pitched roof</td>
<td></td>
</tr>
<tr>
<td>Integrated mechanical ventilation systems</td>
<td>Three-dimensional systems (if part of the product supplied)</td>
<td><strong>Noise levels resulting from mechanical ventilation within:</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Living rooms,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Bedrooms,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Kitchens, and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Bathrooms</td>
</tr>
</tbody>
</table>

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3.5.9 Verification by calculation – Building envelope, airborne sound insulation

3.5.9.1 The airborne sound insulation performance of the intended external wall assembly and roof constructions (from weather face to internally finished inner leaf) may be calculated based on measured or published performance data of individual components/elements in accordance with BS EN ISO 12354-3. The calculations should include all direct and flanking transmission paths, including (but not limited to):

   a) Unglazed areas of external wall,
   b) Glazed areas of external wall,
   c) Windows,
   d) Trickle vents (if included)
   e) Passive ventilators, and
   f) Inlets for mechanical systems

3.5.9.2 For three-dimensional modules, only the elements forming external building envelopes need to be considered for this aspect. If no areas of building envelope are formed from the module, this aspect is not applicable.

3.5.9.3 It is anticipated that several models may be developed for each system type for different configurations of critical elements such as windows in external walls. Each result is only valid for the configuration calculated. The reported output must accurately reflect what variations of elements have been considered for any given output.

3.5.9.4 Where insufficient data exists on specific elements to facilitate the calculation, such as a new wall/window design, then these can be tested in isolation following the guidance given in BS EN ISO 10140-1.

3.5.9.5 Airborne sound insulation performance for the building envelope shall be presented in the following single figure rating:

   \[ R'_w \text{ (dB)}, \]
   \[ R'_w + C'_{tr} \text{ (dB)}, \]
   or
   \[ R_w \text{ (dB)} \]
   \[ R_w + C_{tr} \text{ (dB)} \]

3.5.9.6 Airborne sound insulation performance for the building envelope shall be presented in one-third octave bands between 100 Hz and 3150 Hz in:

   \[ R' \text{ (dB)}, \]
   or
   \[ R \text{ (dB)} \]

3.5.10 Verification by testing – Building envelope, airborne sound insulation

3.5.10.1 The airborne sound insulation characteristics of building envelope sub-assemblies (such as windows or wall sections) or elements (such as vents or inlets) may be tested following the two-dimensional testing guidance in BS EN ISO 10140-1. The test specimen should be from internal face to external, weather facing side. The test results only apply to the
configuration tested.

3.5.10.2 Under certain circumstances, it may be appropriate/desirable to test on-site or in the factory fully assembled parts of, or the entire, building envelope. Guidance is provided in Annex A.2 for three-dimensional testing. The three-dimensional test is only valid for the configuration tested, which may be appropriate for single design solution.

3.5.10.3 Airborne sound insulation performance for the building envelope, the sub-assemblies or elements shall be presented in in the following single figure rating, as appropriate for the element or combination of elements tested:

- $R'_w$ (dB),
- $R'_w + C_{ir}$ (dB),
- or
- $R_w$ (dB)
- $R_w + C_{ir}$ (dB)
- or
- $D_{ne,w}$

3.5.10.4 Airborne sound insulation performance for the building envelope, the sub-assemblies or elements shall be presented in one-third octave bands between 100 Hz and 3150 Hz in:

- $R'$ (dB),
- or
- $R$ (dB),
- or
- $D_{ne}$

as appropriate for the element or combination of elements tested

3.5.11 Verification by calculation – Building envelope, impact sound insulation

3.5.11.1 Not applicable

3.5.12 Verification by testing – Building envelope, impact sound insulation

3.5.12.1 The impact sound insulation characteristics of flat roofs shall be tested where they are accessible/intended for use as an outdoor amenity area such as a roof terrace following the two-dimensional testing guidance in Annex A.1. The test specimen should be from external weather facing side to internal ceiling face. The test results only apply to the configuration tested.

3.5.12.2 Under certain circumstances, it may be appropriate/desirable to test on-site or in the factory fully assembled parts of, or the entire, building envelope. Guidance is provided in Annex A.2 for three-dimensional testing. The three-dimensional test is only valid for the configuration tested.
tested, which may be appropriate for single design solution.

3.5.12.3 For two-dimensional tests, impact sound insulation performance for flat roofs shall be presented in the following single figure rating:

\[ L_{nw} \text{ (dB)} \]

3.5.12.4 For two-dimensional tests, impact sound insulation performance for flat roofs shall be presented in one-third octave bands between 100 Hz and 3150 Hz in:

\[ L_n \text{ (dB)} \]

3.5.12.5 For three-dimensional tests, impact sound insulation performance for flat roofs shall be presented in the following single figure rating:

\[ L'_{nT,w} \text{ (dB)} \]

3.5.12.6 For three-dimensional tests, impact sound insulation performance for flat roofs shall be presented in one-third octave bands between 100 Hz and 3150 Hz in:

\[ L'_{nT} \text{ (dB)} \]

3.5.13 Verification by calculation – Building envelope, rain noise

The impact noise from rain falling on the flat or pitched roof shall be assessed based on data obtained for the roof in accordance with BS EN ISO 10140-1 Annex K subject to “heavy” rain excitation.

The results from the assessment shall be presented in terms of a dB(A) value, due to the rain noise excitation taking account of the complete structure from weather face to room finish for each room type.

The calculations shall be based on representative furnishing levels for units when occupied.

Where the system only represents two-dimensional elements e.g. simply the roof and not enclosing walls to form rooms, the calculations shall be based on assumed geometry representative of typical spaces for each room type.

3.5.14 Verification by testing – Building envelope, rain noise

3.5.14.1 Not applicable

3.5.15 Verification by calculation – Integrated mechanical ventilation systems

The noise from integrated mechanical ventilation systems shall be based on sound power data obtained for the ventilation system in accordance with the relevant part of BS EN 13141.

The assessment should be undertaken in accordance with a published calculation method such as that presented in CIBSE Guide B4 – Noise and vibration control for building services systems. The results shall be presented in terms of a dB(A) value taking account of structure borne noise contributions, if appropriate.

The calculations shall be based on representative furnishing levels for units when occupied.
Where the system does not form completed rooms, the calculations shall be based on assumed geometry representative of typical spaces for each room type.

3.5.16 Verification by testing – Integrated mechanical ventilation systems

The noise due to the ventilation system should be undertaken within enclosed rooms, representative of the completed dwellings. Testing should be undertaken in accordance with an appropriate, published method such as those presented in ANC Guidelines – Noise Measurements in Buildings, Part 1: Noise from Building Services.

The results shall be presented in terms of a dB(A) value and be based on representative furnishing levels for units when occupied.

3.6 ENERGY ECONOMY AND HEAT RETENTION

3.6.1 Requirements

The system shall meet the Building Regulation requirements in England, Wales, Scotland and Northern Ireland, for energy economy and heat retention in construction.

3.6.1.2 Verification by Calculation

3.6.1.2.1 The manufacturer shall demonstrate compliance of the thermal performance of buildings, in accordance with the procedures given in the version of the Building Regulations and Standards currently in force in the appropriate UK administration. For example, Approved Document L1A of the Building Regulations (England and Wales) states that compliance can be demonstrated by meeting the five criteria given in it, which involves the use of approved calculation tools (current versions of the Standard Assessment Procedure (SAP) or the Simplified Building Energy Model (SBEM)) to predict the Dwellings Emission Rate (DER) for comparison with the Target Emission Rate (TER).

3.6.1.2.2 SBEM shall be used if part of the modular construction is for a heated common area in an apartment block.

3.6.1.2.3 Where appropriate, the manufacturer shall submit element U-value calculations in accordance with the following:

- Walls and roofs: BS EN ISO 6946
- Ground floors: BS EN ISO 13370
- Windows and doors: BS EN ISO 10077-1 or BS EN ISO 10077-2
- Basements: BS EN 13370 or the BCA/NHBC Approved Document
- Light steel-frame construction: Digest 465, BRE 2002
- Components outside the scope of the above: BS EN ISO 10211

3.6.1.2.4 The manufacturer shall submit evidence to show that the connections between elements of the building system comply with the regulatory requirements. This can be via utilisation of published Robust Construction Details given in ‘Limiting thermal bridging and air leakage: Robust construction details for dwellings and similar buildings’, or for other connections, via appropriate numerical modelling using data appropriate to the connection configuration.
3.6.1.3 Verification by Testing

3.6.1.3.1 Where a manufacturer chooses to demonstrate compliance by test evidence that evidence shall be in accordance with the following:

- BS EN 12664, BS EN 12667 or BS EN 12939 for thermal conductivity
- BS EN ISO 8990 for thermal transmittance
- BS EN ISO 12567-1 for thermal transmittance of windows and doors

3.7 SECURITY

3.7.1 Requirements

The system shall meet the Building Regulation requirements in England, Wales, Scotland and Northern Ireland, for security in construction.

3.7.2 Verification by Calculation

3.7.2.1 Not applicable.

3.7.3 Verification by Testing/Assessment

3.7.3.1 Physical security

At minimum, all accessible elements shall be demonstrated to meet either LPS 2081 Security Rating B or PAS 24, as appropriate to the type of element. In such cases, the interface between doorsets and windows and the elements to which they are attached shall at least meet the requirements of LPS 2081 Security Rating B\(^1\). Modular dwellings meeting these requirements shall be attributed a Grade 0 forced entry protection level.

Table 3 – Elements and the standards to which they may be evaluated

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Curtain walling / cladding</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Doorsets (Cantilevered)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Doorsets (Folding)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Doorsets (Hinged)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Doorsets (Pivoting)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Doorsets (Revolving)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Doorsets (Sliding)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

\(^1\) This is because PAS 24 does not consider the resistance to removal of doors or windows from the structures into which they are installed.
Where there is a threat of forced entry involving techniques likely to generate noise, all accessible elements shall at least meet the requirements of LPS 1175: Issue 8 Security Rating A3 (Modular buildings attributed a Grade 1 forced entry threat). Meanwhile, all accessible elements on modular dwellings designed to protect against a heightened threat of forced entry involving techniques likely to generate noise shall meet the requirements of LPS 1175: Issue 8 Security Rating B3 (Modular buildings attributed a Grade 2 forced entry threat).

The interconnections and compatibility of elements used to form the modular dwelling shall be assessed to ensure features on each element cannot be exploited in order to undermine the forced entry resistance provided by other elements.

**Note:** An example of this may be the ability of an attacker to access and operate the lock hardware on the rear of a doorset in order to open it by creating a small aperture through an adjacent wall or window.

**Table 4 – Summary of modular dwelling forced entry protection grades**

<table>
<thead>
<tr>
<th>BPS 7014 Modular Dwelling Forced Entry Protection Grade</th>
<th>Standard</th>
<th>Security Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>PAS 24: 2016</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td>LPS 2081: Issue 1</td>
<td>A</td>
</tr>
<tr>
<td>1</td>
<td>LPS 1175: Issue 8</td>
<td>A3</td>
</tr>
<tr>
<td>2</td>
<td>LPS 1175: Issue 8</td>
<td>B3</td>
</tr>
</tbody>
</table>
3.8 DESIGN CHANGE AND SERVICE LIFE PLANNING

3.8.1 Requirements
The system shall meet the Building Regulation requirements in England, Wales, Scotland and Northern Ireland, for design change and service life planning in construction.

3.8.2 Design life planning

3.8.2.1 Verification by Desk Study
The manufacturer shall demonstrate how they have considered potential changes and adaptations that might reasonably be expected to be introduced during the life of the building, if appropriate to the design of the system. This shall include the identification of structure/components that have been readied for future adaptation e.g. strengthened structure, fixing points provided, cabling installed, etc.

3.8.3 Service life planning

3.8.3.1 Verification by Desk Study
The manufacturer shall demonstrate how they have considered the design life of module components, and their maintenance, servicing and replacement requirements. The manufacturer should consider CIBSE TM31 Building Log Book Kit.

The manufacturer shall demonstrate that they have considered the requirements in ISO Standard ISO 15686.

3.9 DURABILITY, RESILIENCE, MATERIALS AND WORKMANSHIP

3.9.1 Requirements
3.9.1.2 The system shall meet the Building Regulation requirements in England, Wales, Scotland and Northern Ireland, for durability, resilience, materials and workmanship in construction. In this Standard the following requirements are adopted:

- The life expectancy of the structural system and inaccessible elements or components shall not be less than 60 years.
- Individual elements or components with shorter life expectancies shall be clearly identified in the installation and/or user manual(s) and their life expectancies stated. In addition, appropriate maintenance, refurbishment and/or replacement schedules for such elements or components shall be supplied.
- The durability, resilience and repairability of building systems shall be assessed against a benchmark residential building constructed using an established method of building.

3.9.2 Verification by Desk Study
3.9.2.1 The manufacturer shall provide sufficient information so that durability can be established by desk study.
3.9.2.2 The manufacturer shall consider the resilience of their system and provide their methodology for repairing the resulting damage, see also section 4.2.

3.9.3 Verification by Testing
3.9.3.1 Flood resilience of doors and frames shall be tested in accordance with, and meet the requirements of, the leakage test requirements of PAS 1188-1.

3.10 SUSTAINABLE USE OF NATURAL RESOURCES
3.10.1 Requirements
The system shall meet the Building Regulation requirements in England, Wales, Scotland and Northern Ireland, for sustainable use of natural resources in construction.

3.10.2 Environmental impact of materials
3.10.2.1 Verification by Assessment
The manufacturer can demonstrate it has taken measures to lower the environmental impact of materials of the finished dwelling by:

1. Procuring products with independently verified environmental product declarations (EPD) in accordance with ISO 14025 and either ISO 21930 or EN 15804. Only two EPDs per compliance group (as defined by Uniclass 2015 code) will be accounted for. A minimum number of two EPD’s will be required from the offsite system manufacture to comply with this standard.

2. Providing information to demonstrate or calculate the environmental impact of the building in terms of BRE 2014 Ecopoint/m² and demonstrate improvement against the benchmark as defined by Home Quality Mark (HQM). This can be done in either of the following ways:
   - Provide the assessor with the required information so that they can carry out the assessment. Information required includes: element location and system profile classification, quantity of the unit of measurement and general dwelling information (e.g. GIA, number of bedrooms, communal areas, etc.)
   - OR carry out the assessment using an IMPACT compliant tool (see http://www.impactwba.com/ for a list of IMPACT compliant tools)

Should the innovative offsite system manufacturer not wish to follow the HQM route, it will still need to comply with the requirements above. With regards to calculating the environmental impact of the building, the manufacturer will either use an IMPACT or an EN 15978 compliant tool.
3.10.3 Life Cycle Costing (LCC) of Construction Products

3.10.3.1 Verification by Assessment

Life Cycle Costing (LCC) analysis is carried out to PD156865 by a suitably qualified cost consultant commencing at the end of Stage 2/RIBA Stage 2. Whilst a full Life Cycle Costing analysis cannot be performed on less than a whole completed building in situ the manufacturer can provide all the information required to perform an LCC for relevant sections so that the building could be fully assessed once installed.

3.10.4 Responsible sourcing of materials/products

3.10.4.1 Verification by Assessment

Legally harvested and traded timber products can be considered as responsibly sourced if all timber and timber-based products used in the building meet the definition of 'legally harvested and legally traded timber'. Guidance is provided in the UK Government's Timber Procurement Policy (TPP).

The manufacturer can demonstrate responsible sourcing of construction products assessment by following the guidance and principals in BS 8900-1 *Managing sustainable development of organizations* and/or ISO 20400 *Sustainable procurement*.

Similarly, the manufacturer should demonstrate compliance with the responsible sourcing certification scheme for BES 6001 *Responsible sourcing framework Standard*.

Additionally, the manufacturer should demonstrate compliance with BES 6002 *Ethical Sourcing Standard*. 

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4 QUALITY MANAGEMENT REQUIREMENTS

This section considers all the actions necessary to manage the quality of the building system throughout its life.

- Practicability of installation (buildability)
- Practicability of repair, replacement and adaptability
- Identification of building systems
- Factory production control
- Handling and storage
- Site Assembly
- Home information
- Building information modelling/management (BIM)
- Information to be supplied by the applicant

4.1 PRACTICABILITY OF INSTALLATION (Buildability)

4.1.1 Verification by Assessment

4.1.1.1 The manufacturer shall provide a set of clear instructions detailing site installation details and assembly procedures, handling and storage instructions, and operator training requirements.

4.1.1.2 The assembly and installation of the system shall be in accordance with the manufacturer's instructions using an appropriately trained or qualified workforce. The manufacturer shall provide a checklist detailing the critical assembly and installation checks for the system, as required, for inspection of on-site construction and quality control by Building Control and/or other appropriate organisations. There shall be a formal handover from substructure contractor to module manufacturer if the substructure contractor is not also the module manufacturer.

4.1.1.3 The installation instructions shall include specifications for the tolerances of ancillary constructions to be provided by others, e.g. foundation levels, so as not to impair the construction of the building.

4.1.1.4 The manufacturer shall provide installation instructions that include specifications for the tolerances of the intermediate stages of the modular building’s construction. This shall include maximum permissible deviations that are specific to the manufacturer’s system, such as deviation from level and twist about the building’s vertical stack axis.

4.1.1.5 The building shall be made weathertight as soon as practicably possible during assembly and installation in order to protect elements and components that may be damaged by water.

4.1.1.6 The manufacturer shall allow the Certification Body to witness assembly and installation at a minimum of one site in order to assess the buildability of the system and to confirm that the methods being used are in accordance with the procedures. This shall include site organisational structure, competency and training of those performing the installation to ensure a satisfactory and repeatable installation.
4.1.1.7 The manufacturer shall ensure that modules cannot sustain long term damage during transportation to site, or during assembly and installation that could go undetected.

4.2 PRACTICABILITY OF REPAIR, REPLACEMENT AND ADAPTABILITY

4.2.1 Verification by Assessment

4.2.1.1 The manufacturer shall provide repair and adaptability procedures for the building system as appropriate. This shall include for replacement of components.

4.2.1.2 The procedures for repair shall consider the requirements resulting from the schedule of specified threats given in Clause 3.9, as applicable to the type of development. The procedures for the adaptation/change of use of building systems should consider the following scenarios, as applicable:

- Insertion of a 2m x 2m opening for a new patio door.
- Fixing of heavy items to internal walls, ceilings and stairs, e.g. stair lift, or ceiling hoist for disabled.
- Fixing of heavy items to external walls.
- Adding a conservatory/porch to an external wall.
- Removal of internal load bearing walls.
- Accessibility for modifications to plumbing and electrics services.
- Cutting or drilling holes through elements or components to accommodate modifications to service requirements.

4.2.1.3 The manufacturer shall provide the recommended approach to damage assessment and repair, taking into account the availability of replacement parts and the degree of inter-connection between different elements in the system. The approach shall also indicate whether repair requires particular levels of competency, e.g. carried out by competent DIY, general tradesperson or specialist contractors.

4.2.1.4 The Developer/Builder shall supply a ‘User/Owner Guide’ that will be given to the Building Owner, which identifies clearly ‘Dos and Don’ts’ that need to be understood before any maintenance, modification or adaptation of the system is undertaken.

4.2.1.5 The User Guide shall indicate the competency required to achieve particular types of modifications or adaptations (see clause 4.2.1.1.2). It shall also include key information relating to the construction, e.g. wall and floor drawings, positions of services etc., and be capable of being updated to record work done throughout the life of the building.

4.2.1.6 Whilst this Standard does not consider sanitation, hot water safety and efficiency, drainage and waste disposal, and heat producing appliances as they are covered by CE Marking, consideration shall be given to accessing these services for repair or replacement. The Manufacturer can provide a report to demonstrate this.
4.3 IDENTIFICATION OF BUILDING SYSTEMS

To prevent inadvertent damage from works or to enable repair and maintenance to be carried out effectively, future occupants of residential buildings, and any professionals/contractors engaged by them, shall have ready access to information about the design and construction of that building (see clause 4.7). Each system supplied shall have a data sheet provided to the owner. The data provided shall meet the following requirements.

4.3.1 Verification by Assessment

4.3.1.1 The building system shall be unambiguously identifiable by an overt marking device.

4.3.1.2 The identification system shall incorporate at least one form of overt marking device placed in a suitable location on the building, e.g. in an external service/meter box, so as to be readily accessible by the occupier, professionals and contractors, yet be secure from accidental or deliberate damage.

4.3.1.3 The manufacturer of a module or system shall provide at least one overt marking device on each module or system which records the following information:

1. A unique identification code for each building system delivered and batch reference.
2. The name and contact details (e.g. web site or phone number) of the system manufacturer and postcode of manufacturing facility.
3. The name and contact details of developer.
4. A code to identify the Building Control Body used.
5. A code to identify which UK Building Regulations compliance applies to, i.e. England, Scotland, Wales, Northern Ireland, or a combination of countries.
6. The year of manufacture and year of installation (if different).
7. The name/reference for the system.
8. The Certificate number and issuing authority.

4.3.1.4 The manufacturer may have a documented process for demonstrating tracking of components and modules. This might feature ‘Tag and Track’ or the use of Quick Response Codes (QRC) or maintain an as-built condition record. A Tag and track system using radio frequency identification (RFID) tags/QRC barcodes can allow real-time monitoring of components and elements from the supply chain, through the manufacturing process, transportation to site and storage, site construction and the operations and maintenance of the completed building. Once installed the tagged components will remain for the life-cycle of the building, providing accurate information to those that need it.

4.3.2 Verification by Testing

4.3.2.1 Overt marking devices shall withstand a test for resistance to removal or damage in accordance with manual intervention testing specified in LPS 1225, or similar.
4.4 FACTORY PRODUCTION CONTROL

Some of the purposes of control of the manufacturing are to produce product which meets design intent, and which complies with the design specification and the requirements of this Standard.

4.4.1 Verification by Assessment

4.4.1.1 The manufacturer’s Factory Production Control procedures shall be in accordance with BRE Global Ltd.’s document PN 111 ‘Factory Production Control’ requirements.

4.4.1.2 The manufacturer shall have a Production Control Plan available at the start of the Certification Body’s assessment. The plan shall list the raw materials used, show the means of verification of their quality, the type and frequency of in-process and final testing of the product and the associated performance (pass/fail) requirements.

4.4.1.3 The manufacturer shall establish key performance indicators for its supply chain.

4.4.1.4 The manufacturer may have a “Design Authority” to clarify accountability for owning design intent, the method of manufacture, verification, change and non-conformance. The Design Authority controls how design specification is approved, released and changed. The Design Authority controls, or can delegate, the method of manufacture/verification and assessment/permit of non-conformance.

4.4.1.5 Where manual on-site processes have been automated, the manufacturer shall demonstrate that potential failure modes, for example due to input material or process, have been identified and mitigated to an ALARP (as low as reasonably practicable) level.

4.5 HANDLING AND STORAGE (Factory and Site)

4.5.1 Verification by Assessment

4.5.1.1 Handling (lifting and transporting) and storage activities shall not cause damage and/or ingress of moisture, nor impair the intended performance of building systems when subsequently erected to form the building. Guidance shall be provided for handling and lifting activities. This shall include factory activity and site installation requirements.

4.5.1.2 Guidance shall be provided for the storage of modules, part modules or components at the factory and include intermediate in-transit storage which might be of many months duration. This shall include provision for weatherproofing where modules or systems are stored before installation.

4.5.1.3 No elements damaged during handling and storage shall be used in construction of building unless specifically authorised by a competent engineer.

4.5.1.4 The manufacturer shall demonstrate that no part of the system is adversely affected from handling, transporting and lifting or from the support conditions in storage. The manufacturer shall have a documented procedure for demonstrating transportation, handling and lifting.

4.5.2 Verification by Testing

Testing, if required to demonstrate any of the above requirements, shall be determined by the Certification Body.
4.6 SITE ASSEMBLY

The manufacturer shall demonstrate the following requirements. Additionally, these requirements apply where a manufacturer uses an installer who is not part of the manufacturer, but is an installer approved by the manufacturer. Note that installation shall only be undertaken by the manufacturer or an installer approved by the manufacturer.

4.6.1 Verification by Assessment

4.6.1.1 The manufacturer shall provide full detailed site installation/assembly instructions including any diagrams for use by the site installer.

4.6.1.2 The manufacturer shall identify relevant competency and/or training requirements for installers.

4.6.1.3 The manufacturer shall provide risk assessments for the installation and construction process inspection.

4.6.1.4 The manufacturer shall identify requirements for checking workmanship of the installation, which could involve providing a site quality check list.

4.6.1.5 The manufacturer/developer (as appropriate) shall consider how they ensure that the installation is completed to a satisfactory standard.

4.6.1.6 The manufacturer shall identify any specialist installation equipment and tools that are needed.

4.6.1.7 The manufacturer or approved installer shall ensure the marking (labelling) is in place (see clause 4.3) to signify that the installation has been completed to their satisfaction in accordance with clause 4.6.

4.7 HOME INFORMATION

4.7.1 Verification by Assessment

4.7.1.1 The manufacturer shall make available a Health and Safety File to comply with the Construction Design and Management (CDM) Regulations, which require a Health and Safety File to be prepared and handed over to the Client. The file is a record of all information for the client/end user, which tells those persons who might be responsible for the structure in the future of the risks that have to be managed during maintenance, repair, renovation and demolition. Typical contents include; as built drawings, operational manuals for any equipment, mechanical and electrical service drawings, details of emergency provisions, details of hazardous substances/materials which could give rise to risk of injury, maintenance schedules, etc.

4.7.1.2 In addition to satisfying the CDM regulations the manufacturer shall provide a User Manual to enable the end user to run their building effectively. It shall describe the building system, including thermal performance characteristics, and the ‘Dos and Don’ts’ that need to be understood before any maintenance, or adaptation, of the system is undertaken, and allows for work carried out to be recorded. The User Manual should form part of the Health and Safety File for the building.

4.7.1.3 The Dwelling Management Guide and Logbook shall include a list of examples of additions or adaptations identifying any installation constraints. Constraints may range from
excluding works altogether, to limiting works to areas of the building which incorporate suitably reinforced construction. Examples of additions might include PV panels, wind turbines, washing lines, basketball hoops, awnings, aerials, examples of adaptations might include balconies, patio doors etc.

### 4.8 BUILDING INFORMATION MODELLING (BIM)

**4.8.1 Verification by Assessment**

4.8.1.1 Whilst non-mandatory it is considered Construction Industry best practice to utilise Building Information Modelling (BIM) in co-ordinating construction projects. Internationally, BIM is addressed in BS EN ISO 12006–2, BS EN ISO 12006-3 and BS EN ISO 19650 Series. For the UK national implementation of ISO 12006 see Uniclass 2015. The manufacturer should achieve Uniclass 2015 classification for the components and system.

4.8.1.2 Whilst non-mandatory it is suggested that the information considered as part of BIM should be carried through to an AIM (Asset Information Model) for user/owner/maintainer etc. to use and update through the life of the building.
5 RELEVANT UK REGULATIONS, STANDARDS AND PUBLICATIONS

The relevant regulations at the date of publication of this standard are listed for completeness.

5.1 Regulations

a) The Building Regulations (England) 2010: Requirements
Building (Amendment) Regulations 2018, S.I. 2018 No.1230 (the “Amendment Regulations”), England
https://www.gov.uk/government/collections/approved-documents
http://www.gov.scot/Topics/Built-Environment/Building/Building-standards
c) The Building Regulations (Wales) 2010: Requirements
http://gov.wales/topics/planning/buildingregs/approved-documents
d) The Building Regulations (Northern Ireland) 2012
http://www.buildingcontrol-ni.com/regulations
e) The Health and Safety at Work etc Act 1974
f) Construction (Design and Management) Regulations 2015

g) Technical housing standards – nationally described space standard 2015 (Amended 2016)

5.2 Standards referred to in BPS 7014

BS 476-20 Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles)
BS 585–2 Wood Stairs. Specification for performance requirements for domestic stairs constructed of wood-based materials
BS 5250 Code of practice for control of condensation in buildings
BS 5266-1 Emergency lighting. Code of practice for the emergency escape lighting of premises
BS 5395-1 Stairs. Code of practice for the design of stairs with straight flights and winders
BS 6100 series of standards: Glossary of building and civil engineering terms.
BS 6180 Barriers in and about buildings. Code of practice
BS 7671:2018 Requirements for Electrical Installations. IET Wiring Regulations
BS 8102 Code of Practice for protection of structures against water from the ground
BS 8300 Design of buildings and their approaches to meet the needs of disabled people
BS 8485 Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings
BS 8900-1 Managing sustainable development of organizations - Guide
BS EN 717-1 Wood-based panels. Determination of formaldehyde release. Formaldehyde emission by the chamber method
BS EN 1838 Lighting applications. Emergency lighting.
BS EN 1990 UK National Annex for Eurocode. Basis of structural design
BS EN 1991-1-2 UK National Annex to Eurocode 1: Actions on structures. General actions. Actions on structures exposed to fire
BS EN 1991-1-7  Eurocode 1. Actions on structures. General actions. Accidental actions
BS EN 12086  Thermal insulating products for building applications. Determination of water vapour transmission properties.
BS EN 12664  Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Dry and moist products of medium and low thermal resistance
BS EN 12667  Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Products of high and medium thermal resistance
BS EN 12939  Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Thick products of high and medium thermal resistance
BS EN 13141-1  Ventilation for buildings. Performance testing of components/products for residential ventilation. Externally and internally mounted air transfer devices
BS EN 13141-2  Ventilation for buildings. Performance testing of components/products for residential ventilation. Exhaust and supply air terminal devices
BS EN 13141-3  Ventilation for buildings. Performance testing of components/products for residential ventilation. Exhaust and supply air terminal devices
BS EN 13141-4  Ventilation for buildings. Performance testing of components/products for residential ventilation. Fans used in residential ventilation systems
BS EN 13141-5  Ventilation for buildings. Performance testing of components/products for residential ventilation. Cowl and roof outlet terminal devices
BS EN 13141-6  Ventilation for buildings. Performance testing of components/products for residential ventilation. Exhaust ventilation system packages used in a single dwelling
BS EN 13141-7  Ventilation for buildings. Performance testing of components/products for residential ventilation. Performance testing of a mechanical supply and exhaust ventilation units (including heat recovery) for mechanical ventilation systems intended for single family dwellings
BS EN 13141-8  Ventilation for buildings. Performance testing of components/products for residential ventilation. Performance testing of un-ducted mechanical supply and exhaust ventilation units (including heat recovery) for mechanical ventilation systems intended for a single room
BS EN 13141-9  Ventilation for buildings. Performance testing of components/products for residential ventilation. Externally mounted humidity controlled air transfer device
BS EN 13141-10  Ventilation for buildings. Performance testing of components/products for residential ventilation. Humidity controlled extract air terminal device
BS EN 13141-11  Ventilation for buildings. Performance testing of components/products for residential ventilation. Supply ventilation units
BS EN 13501-1  Fire classification of construction products and building elements, Part 1 – Classification using data from reaction to fire tests
BS EN 13501-2  Fire classification of construction products and building elements, Part 2 – Classification using data from fire resistance tests (excluding products for use in ventilation systems)
BS EN 13501-5  Fire classification of construction products and building elements. Classification using data from external fire exposure to roofs tests
BS EN 13999 Pts 1-4  Adhesives. Short term method for measuring the emission properties of low-solvent or solvent-free adhesives after application
BS EN 15804  Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products.
BS EN 16402  Paints and varnishes. Assessment of emissions of substances from coatings into indoor air. Sampling, conditioning and testing
BS EN 50172  Emergency escape lighting systems.
BS EN ISO 717-1  Acoustics. Rating of sound insulation in buildings and of building elements. Airborne sound insulation
BS EN ISO 717-2  Acoustics. Rating of sound insulation in buildings and of building elements. Impact sound insulation
BS EN ISO 8990  Thermal insulation. Determination of steady-state thermal transmission properties. Calibrated and guarded hot box
BS EN ISO 10077-1  Thermal performance of windows, doors and shutters. Calculation of thermal transmittance. Simplified method
BS EN ISO 10140-1  Acoustics. Laboratory measurement of sound insulation of building elements. Application rules for specific products
BS EN ISO 10140-2  Acoustics. Laboratory measurement of sound insulation of building elements. Measurement of airborne sound insulation
BS EN ISO 10140-3  Acoustics. Laboratory measurement of sound insulation of building elements. Measurement of impact sound insulation
BS EN ISO 10140-4  Acoustics. Laboratory measurement of sound insulation of building elements. Measurement procedures and requirements
BS EN ISO 10140-5  Acoustics. Laboratory measurement of sound insulation of building elements. Requirements for test facilities and equipment
BS EN ISO 10211  Thermal performance of buildings. Heat transfer via the ground. Calculation methods
BS EN ISO 11654  Acoustics. Sound absorbers for use in buildings. Rating of sound absorption
BS EN ISO 12006-3  Building construction. Organization of information about construction works. Framework for object-oriented information
BS EN ISO 12354-3  Building acoustics. Estimation of acoustic performance of buildings from the performance of elements. Airborne sound insulation against outdoor sound
BS EN ISO 12567-1  Thermal performance of windows and doors. Determination of thermal transmittance by hot box method. Complete windows and doors
BS EN ISO 13370  Thermal performance of windows and doors. Determination of thermal transmittance by hot box method. Complete windows and doors
BS EN ISO 13788  Hygrothermal performance of building components and building elements: Internal surface temperature to avoid critical surface humidity and interstitial condensation. Calculation methods
BS EN ISO 14025  Environmental labels and declarations. Type III environmental declarations. Principles and procedures.
BS EN ISO 16000-6  Indoor air. Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA sorbent, thermal desorption and gas chromatography using MS or MS-FID
BS EN ISO 16000-9  Indoor air. Determination of the emission of volatile organic compounds from building products and furnishing. Emission test chamber method
BS EN ISO 16017-2  Indoor, ambient and workplace air. Sampling and analysis of volatile organic compounds by sorbent tube/thermal desorption/capillary gas chromatography. Diffusive sampling
BS EN ISO 16283-1  Acoustics. Field measurement of sound insulation in buildings and of building elements. Airborne sound insulation
BS EN ISO/IEC 17025  General requirements for the competence of testing and calibration laboratories
BS EN ISO 19650 Series Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM). Information management using building information modelling

BS EN ISO 20354 Acoustics. Measurement of sound absorption in a reverberation room

BS ISO 15686-1 Buildings and constructed assets - service life planning - Part 1: General principles and framework

BS ISO 15686-2 Buildings and constructed assets - service life planning - Part 2: Service life prediction procedures

BS ISO 15686-3 Buildings and constructed assets - service life planning - Part 3: Performance audits and reviews


PD 6688-1-2 Background paper to the UK National Annex to BS EN 1991-1-2

ISO 20400 Sustainable procurement

ISO 21930 Sustainability in buildings and civil engineering works. Core rules for environmental product declarations of construction products and service

Other publications


BCA Technical Guidance Note 20: Ensuring adequate ventilation to naturally-ventilated dwellings with high levels of as-built air permeability

BES 6001 Responsible sourcing of construction products

BES 6002 Ethical labour sourcing

BRE BR 209 Site layout planning for daylight and sunlight: a guide to good practice

BRE BR 211 Radon: Guidance on protective measures for new buildings

BRE BR364 Solar shading of buildings

BRE DG498 Selecting lighting controls

BRE Digest 464 Part 2 VOC emissions from building products - Control, evaluation, and labelling schemes

BRE IP 4-14 People-friendly lighting controls

CIBSE Guide A Environmental Design to be used for building design

CIBSE AM11 Building Energy and Environmental Modelling

CIBSE Guide B4 Noise and vibration control for building services systems

CIBSE LG09 Lighting Guide 9: Lighting for Communal Residential Buildings


CIBSE LG12 Lighting Guide 12: Emergency Lighting

CIBSE TM21 Minimising Pollution at Air Intakes

CIBSE TM31 Building log book Kit

CIBSE TM52 Limits of Thermal Comfort: Avoiding Overheating

CIBSE TM59 Design methodology for the assessment of overheating risk in homes

CIBSE TM60 Good practice in the design of homes


CWCT Technical Note TN 41 Site testing for watertightness

ETAG 023 Guideline for European Technical Approval of Prefabricated Building Units

GD021 BRE Guidance Document (Acoustics)

ILP GN01 Guidance Notes for the Reduction of Obtrusive Light
<table>
<thead>
<tr>
<th>BRE PRODUCT STANDARD</th>
<th>BPS 7014</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 2021</td>
<td>Page 50 of 64</td>
</tr>
</tbody>
</table>

- **LPS 1175**: Specification for testing and classifying the burglary resistance of building components, strongpoints and security enclosures
- **LPS 1225**: Requirements for the LPCB Approval and Listing of Asset Marking Systems.
- **LPS 1270**: Specification for testing and classifying the burglary resistance of security glazing and glazing films
- **LPS 1501**: LPCB Fire Standard for Innovative Construction Methods
- **LPS 2081**: Requirements and testing procedures for the LPCB approval and listing of building components, strongpoints, security enclosures and free-standing barriers offering resistance to intruders attempting to use stealth to gain entry.
- **NHBC 6.4/10**: Technical Guidance: Recessed light fittings in ceilings to intermediate floors in houses
- **NHBC 8.1/17**: Technical Guidance: Wiring to wall lights
- **PAS 24**: (untitled refers to testing and assessing security performance of doorsets and windows)
- **PAS 1188-1**: Flood protection products — Specification, Part 1: Building aperture products
- **PN 111**: Generic Factory Production Control Requirements, BRE Global Ltd
- **UK Police Service**: - Secured by Design interpretive document for BS EN 1627, BS EN 1628, BS EN 1629, and BS EN 1630.
- **Uniclass 2015**: Unified classification for UK construction sectors

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ANNEX A.1  Separating Walls/Floors and Internal Walls/Floors: Test Methods

A.1.1  Test Method: Two-dimensional tests
A.1.1.1  For two-dimensional systems/elements, testing shall be undertaken within an acoustic laboratory. The testing shall be undertaken in accordance with the BS EN ISO 10140 series of test Standards, within a laboratory that is UKAS accredited for the testing.

A.1.1.2  For wall elements, the test specimen shall be at least 2.3m in height with an overall area of 8-12m². The actual specimen dimensions shall generally be dictated by typical wall panel/module size and may consist of multiple panels/modules.

A.1.1.3  For floor elements, the test specimen shall be at least 2.3m along the shortest dimension with an overall area of 10-20m². The actual specimen dimensions shall generally be dictated by typical wall panel/module size and may consist of multiple panels/modules.

A.1.1.4  The sample tested shall be representative of the actual system and fabricated within the factory and subsequently installed within the laboratory. The test sample shall not be delivered as a kit form and assembled at the laboratory unless this is the same process as expected when the system/element goes to site or unless the test sample can replicate the completed system/element including fixing type and manner.

A.1.1.5  If required for installation purposes, the test sample may be supplied as sub-assemblies/modules/panels provided that the final sample replicates that of the actual system/element when installed on-site. Where this cannot be achieved, any differences between the sample and actual system must be clearly identified in the test report/evidence submission.

A.1.1.6  If the test specimen does not fully fill the test opening within the laboratory, then the remainder shall be infilled with a high-performance construction to avoid flanking sound transmission limiting the tested performance.

A.1.1.7  Care should be taken to reduce sound transmission at the interface between the test specimen and the acoustic laboratory/infill construction.

A.1.1.8  For the two-dimensional test, the perimeter junction need not replicate expected site installation though care should be taken to avoid adverse levels of sound transmission.

A.1.2  Test Method: Three-dimensional test
A.1.2.1  For three-dimensional testing the tests shall be conducted in accordance with BS EN ISO 140-4:1998 and BS EN ISO 140-7:1998 (floors only) by a testing organisation (or individual) that is either:

a. UKAS accredited to undertake testing to BS EN ISO 140-4 & 7:1998 (Tests to these standards are accepted for the purposes of this Standard, since they are explicitly referenced in UK Building Regulations although these standards have been superseded by BS EN ISO 16283-1&-2. Tests to the relevant parts of BS EN ISO 16283 will be accepted as well.); or

b. A member of the ANC pre-completion registration scheme;
A.1.2.2 The test specimen shall comprise three-dimensional module(s) as required to form at least a pair of rooms/spaces of at least 30m$^3$ in each case.\textsuperscript{2} The test specimen may be located within the factory, at a bespoke testing facility or on-site.

A.1.2.3 Where the three-dimensional modules come together to form a separating wall then they shall be placed/connected horizontally (See Diagram A below).

A.1.2.4 Where the three-dimensional modules come together to form a separating floor then they shall be placed/connected vertically (See Diagram B below).

A.1.2.5 Where the three-dimensional modules come together to form a separating wall and separating floor then the two modules can be re-configured between testing or a third module included, typically at lower level but upper level is also acceptable (See Diagram C below).

Diagrams of typical test assemblies for three dimensional tests of separating walls/floors and internal walls/floors

\begin{itemize}
\item[(A)] Placed horizontally
\item[(B)] Placed vertically
\item[(C)] Three modules
\end{itemize}

\textsuperscript{2} Where three-dimensional modules do not form a complete enclosure then temporary works shall be used to close off missing elements/constructions. Care should be taken to ensure that any temporary work performs at least as well as the adjoining structures will in practice. Details of temporary works shall be provided within the test report/submission.
A.1.2.6 In the case of doorways or other openings, temporarily to allow access for testing or as intended for the final system, it is recommended that they be situated as far from those located in the adjoining system (wall or floor) as reasonably practicable to avoid undue transmission.

A.1.2.7 All doors and windows intended as part of the three-dimensional module shall be present and operable for the testing. If openings are part of the module but doors/windows are not, then the opening shall be over boarded (or similar temporary works) as necessary to prevent undue adverse sound transmission. Details of any works not part of the module required to facilitate the test shall be reported accordingly.

A.1.2.8 All wall, floor and ceiling finishes shall be present, but need not be decorated, as expected in the finished building. Where finishes do not form part of the three-dimensional module then, if considered to affect acoustic performance, they shall be introduced in a representative/temporary manner.

A.1.2.9 Carpets shall not be present for impact tests, where the system tested is acting as separating floor.
ANNEX A.2 Building Envelope APD Test Methods

A.2.1 Additional performance declarations (APD) (non-Building Regulations)
A.2.1.1 For APD, the most practical test for the system shall be used. Two-dimensional tests will generally be more straightforward, however three-dimensional testing may be more appropriate depending on the situation.

A.2.2 APD two-dimensional tests
A.2.2.1 Where constructional elements, such as infill wall, have already been tested in a two-dimensional test then the test results can be used for Additional Performance Declaration (APD).

A.2.2.2 Where the system has not already been tested then the testing described in Annex A.1 shall be followed.

A.2.2.3 Ideally, multiple elements shall be combined to form complete parts of the building envelope from the weather facing side to the internal face and all elements between. This approach will reduce the total number of tests undertaken and provide the most information. Care must be taken to test different variants representative of the different permutations of the building envelope. For example, in respect of an external wall, all different façade configurations shall be tested as appropriate for the system. Reliance must not be placed on previous test data where different, even similar components have been tested.

A.2.3 APD three-dimensional tests
A.2.3.1 For three-dimensional testing the airborne sound insulation tests shall be conducted in accordance with either BS EN ISO 16283-1 or BS EN ISO 16283-3:2016. The test specimen should be representative of a part of the completed building envelope to include doors and windows as required to represent the final product. For flat roof elements only, additionally, impact sound insulation performance shall be measured in accordance with BS EN ISO 16283-2.

A.2.3.2 The test specimen shall comprise three-dimensional module(s) as required to form an enclosed volume of at least 30m³ with an envelope area of at least 10m². The test specimen may be located within the factory, at a bespoke testing facility or on-site.

A.2.3.3 When located within the factory or bespoke testing facility, an open-ended test chamber shall be formed/abutted to the test specimen (horizontally for wall systems and vertically for roof systems) such that a pair of enclosed spaces/rooms are formed. It may be convenient to have the opening of the test chamber to be smaller than the representative area of external wall, to reduce the potential for leakage/indirect sound transmission. The test chamber need not be the same size/dimensions the enclosed space of the test specimen, but it shall have an enclosed volume of at least 30m³ and preferably 50m³. Specialist, acoustic

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3 Where three-dimensional modules do not form a complete enclosure then temporary works shall be used to close off missing elements. Care should be taken to ensure that any temporary work performs at least as well as the adjoining structures will in practice. Details of temporary works shall be provided within the test report/submission.

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design input would usually be required for developing the test chamber to ensure representative and repeatable test results can be achieved.

**Diagrams of test arrangement for three-dimensional tests for APD of the building envelope**

A.2.3.4 Where the test specimen is located outside, then the Global loudspeaker method described in BS EN ISO 16283-3:2016 shall be used. If this is not practical, then the Global road traffic noise method shall be used.

A.2.3.5 All doors and windows intended as part of the three-dimensional module shall be present and operable for the testing. If openings are part of the module but do not form part of the building envelope, then the opening shall be over boarded (or similar temporary works) as necessary to prevent undue adverse sound transmission. Details of any works not part of the module required to facilitate the test shall be reported accordingly.

A.2.3.6 All wall, floor and ceiling finishes shall be present, but need not be decorated, as expected in the finished building. Where finishes do not form part of the three-dimensional module then, if considered to affect acoustic performance, they should be introduced in a representative manner.

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ANNEX B - Fire test and performance requirements for whole modules

B.1 SCOPE

This methodology provides a specification for fire testing and classification of whole module systems used in the UK.

B.2 PERFORMANCE IN FIRE

B.2.1 General Requirements

The requirements given below are specifically in relation to the method of test described in this standard. The basis for performance criteria are to:

- minimise the effect of fire on the building itself;
- limit the effects of interruption to the use of a building;
- allow the building to be re-occupied as soon as possible after a fire incident.

B.2.2 Passive fire protection requirements

B.2.2.1 Structural collapse

The building system shall have adequate fire protection to prevent collapse or partial collapse and exhibit restricted deflections.

B.2.2.2 Compartmentation

The building system shall be constructed in such a manner that, if a fire starts, the extent of fire and smoke damage will be minimised. Fire shall not enter into an adjoining property and shall, as far as possible, be prevented from entering concealed cavities or roof voids. If fire does enter any cavities or voids, its spread shall be minimised by appropriate design and/or fire protection measures. Consideration shall be given in the design of the building to limit the spread of smoke into adjoining properties.

Note: although smoke densities are not measured as part of this test and do not form part of the acceptance criteria, fire spread routes will provide a good indicator of potential smoke spread routes.

B.2.3 Active fire protection systems

The building system shall comply with the acceptance criteria in clause B.3.2 without any active protection during the test. The definition of design fire load density \(q_{f,d}\) in accordance with BS EN 1991-1-2 and the UK National Annex and Non-Contradictory Complementary Information contained in PD 6688-1-2 incorporates a reduction factor to be used where an approved life safety sprinkler system is present.

Note: enhanced fire protection to approved building systems may be achieved by the installation of LPCB approved active fire protection systems and should therefore be considered in order to further reduce the risk.
B.3 TEST METHOD AND REQUIREMENTS

B.3.1 Full-Scale Natural Fire Test

Due to the inherent risks involved with large scale fire tests, great care shall be taken at all stages of the procedure (including, but not exclusive to, build and preparation, loading and unloading, test, monitoring and inspection, and dismantling). A full risk assessment and method statement shall be prepared and agreed by all parties for each system test undertaken.

B.3.1.1 General

In order to demonstrate performance in fire of innovative building systems, including the interaction between floors and walls, fire stopping around openings and the correct functioning of cavity barriers, the full-scale test described in this standard is required. BRE Global shall advise the manufacturer of the precise specification for the test so as to obtain the broadest application from the results, but taking into account the generic configuration described in B.3.1.2 This is normally interpreted to select the specification that is anticipated to achieve the lowest level of performance.
B.3.1.2 Test Building

The test building shall comprise a single module incorporating both a ceiling/floor junction and a party wall junction (see figure B.1). It shall be constructed with its intended internal and external finishes but excluding any contents including floor coverings or furnishings. The module shall have dimensions as near as possible to 6m long by 4m wide or the nearest specific size available in the manufacturer’s range (to be decided by BRE Global). The overall dimensions of the test compartment will be representative of the intended end use application and will simulate the accommodation area of one floor of a single building system unit. The test compartment will be constructed with a party wall junction adjacent to the module and a compartment floor junction above the fire compartment.

The wall and floor adjacent to and above the fire compartment will be lined in accordance with the manufacturer’s requirements. The unit above will be loaded uniformly over the floor area to provide a value of imposed load as defined in B.3.1.6. Each building system unit shall be supplied with cables and service connections and penetrations appropriate to the intended end use.

Ventilation shall be provided by unglazed window openings usually on the front elevation of the test building. Their size and location will reflect normal building practice and will be typical for the intended end use application but would be expected to provide a ventilation area approximately equivalent to between 10 and 20% of the floor area. The ventilation conditions operable during the fire test will be determined by BRE Global in order to provide the relevant ventilation to achieve the required fire exposure. However, this will, as far as is practical, reflect the situation related to the end use application.
B.3.1.3 Fire load/ Ignition source

The fire load for the test shall comprise a number of softwood cribs distributed uniformly on the floor of the fire compartment. Each crib shall consist of rough sawn lengths of kiln dried Redwood/Scots Pine or similar softwood sticks each 50mm x 50mm x 1000mm long *. The timber sticks shall be laid with alternate layers arranged mutually perpendicular in a criss-cross fashion. The timber sticks shall be spaced 50mm apart in each layer. The moisture content of the timber shall be measured prior to testing and shall be in the range of 7-13%. Cribs shall be equally spaced over the entire floor area and be a minimum of 300mm apart from each other. Consideration shall be given to suitable and safe access for ignition.

* Note; the length of the sticks may be reduced to a minimum of 500mm should the size of the test building be such that longer sticks cause problems with loading, however the nominal fire loads described below shall be maintained.

Each crib shall be ignited by applying a flame to strips of paraffin-soaked fibre insulation board (12mm x 12mm section) connecting each crib to the adjacent cribs and positioned between the lower two layers.

The crib specification shall be calculated by BRE Global to represent a nominal fire load based on the floor area and the intended end use of the building system. The final choice of the fire load density will be based on the concept of time equivalence (see Annex B.4 and B.5) to provide a natural fire exposure with an equivalent fire severity to the design fire resistance for the specific application.

B.3.1.4 Temperature measurements

Internal atmosphere temperatures shall be measured 100mm and 300mm below the ceiling of the fire compartment using 1.5mm diameter stainless steel sheathed thermocouples (or equivalent in terms of response time) with at least one location per 2m² of ceiling area. Temperatures of the outer surfaces of the fire compartment (internal surface of adjoining compartment and floor surface of the compartment above) shall be measured using thermocouples of the type specified in BS 476: Part 20: 1987 (Method for determination of the fire resistance of elements of construction) for measuring the temperatures of the unexposed surface of partitions/roofs. They shall be positioned on the surface of the wall and floor above with at least 5 on each element to measure mean temperatures. Additional temperature measurements shall be required on both sides of all cavity barriers to assess performance. Additional instrumentation may be installed at the request of the manufacturer to provide information on the response of floor (joists), wall (studs) and connecting elements.

Subject to the agreement of BRE Global, instrumented indicative protected steel elements may also be placed within the centre of the fire compartment (supported on protected steel trestles) to provide information on the time equivalent value of the fire in relation to an equivalent period in a standard test furnace.
B.3.1.5 Video record

A photographic and video recording of the fire test shall be provided by the test laboratory. This shall include video coverage of the internal aspects of the adjoining test buildings with one or more cameras positioned to monitor the compartment wall/floor as applicable.

B.3.1.6 Loading

The floor of the compartment above the test compartment shall be loaded to provide a uniformly distributed load equal to:

<table>
<thead>
<tr>
<th>Purpose group</th>
<th>Load (kN/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>0.75</td>
</tr>
<tr>
<td>Offices</td>
<td>1</td>
</tr>
<tr>
<td>Hotel</td>
<td>0.75</td>
</tr>
<tr>
<td>Shop</td>
<td>2</td>
</tr>
<tr>
<td>School</td>
<td>1</td>
</tr>
</tbody>
</table>

Table B.1. Compartment floor loadings

Note: currently modules intended for residential use only are covered by BPS 7014

B.3.1.7 Full-scale natural fire test procedure

The test shall be conducted under cover to avoid variations due to weather. Ambient temperatures shall be between 5ºC and 25ºC.

B.3.1.7.1 Start of test
The test shall be started by igniting the timber cribs simultaneously or in succession, provided that all of the cribs are ignited within 60 seconds.

B.3.1.7.2 Gas temperatures
Gas temperatures shall be recorded continuously or at intervals not exceeding 30 seconds. Surface or component temperatures shall be recorded at intervals not exceeding 1 minute.

B.3.1.7.3 Integrity
Integrity shall be monitored throughout the test by visual inspection to record any signs of flames outside the compartment of origin.

B.3.1.7.4 End of test
The fire shall be allowed to burn out and the test continued until conditions have stabilized. Any residual burning embers can be extinguished at this point.

Note: The laboratory shall reserve the right to end the test at any time if there is considered to be any risk to the health and safety of the persons or property involved in the test.
B.3.2 Acceptance criteria

Fire breaking through windows shall not be taken as failure under the criteria given below:

B.3.2.1 Integrity criteria

The integrity of the building system shall be demonstrated if the fire is restricted to the compartment of origin for the duration of the test.

B.3.2.1.1 Adjacent building system units

Any break through into the adjoining building system units will constitute a failure and will be recorded with respect to the time from ignition.

B.3.2.1.2 Cavities

Any break through into any cavity will be assessed in terms of restricted extent of damage. Spread beyond the cavities immediately adjacent to the compartment of origin (wall or floor) will constitute a failure.

B.3.2.2 Insulation criteria

The insulation criteria shall be met if the temperature on the unexposed surface of adjoining building system units, i.e. the party wall and the floor of the compartment above, remains below an average value of 200°C and a peak value of 240°C for the entire duration of the fire exposure including the cooling phase.

B.3.2.3 Stability criteria

The load bearing capacity of the building system shall be met if the floor above continues to support the applied load for the duration of the test.

B.3.2.4 Equivalent time of fire exposure

In order to assess performance, the severity of the natural fire shall be evaluated with respect to an equivalent period in a standard fire test. The equivalent period of fire resistance shall be determined either by calculation or direct measurement in accordance with Annex B.4 or B.5.
B.3.3 Test report

The test report shall provide the following information:

- a full description of the building tested including drawings. These shall include full cross sectional details of the building envelope and material specifications;
- loading calculations as appropriate;
- graphs and tables of all measured temperatures;
- observations and photographs taken before, during and after the test;
- results in terms of clause B.3.2 of this Standard;
- a statement provided as either an annex to the report or as a separate document regarding the field of application of the test results.

B.3.4 Field of application of test results

B.3.4.1 General

The results of the test shall apply only to the specification tested or by application of LPCB extended application rules.

B.3.5 Classification

The grading below takes into account the variations between structural load and fire load. To reduce the number of classes, some increase in fire load for specific purpose groups has been introduced.

<table>
<thead>
<tr>
<th>Grade designation</th>
<th>Purpose groups covered</th>
<th>Load (kN/m²)</th>
<th>Nominal fire load (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMC1</td>
<td>Retail</td>
<td>2</td>
<td>Based on specified requirement</td>
</tr>
<tr>
<td>MMC2</td>
<td>Residential</td>
<td>0.75</td>
<td>Based on specified requirement</td>
</tr>
<tr>
<td>MMC3</td>
<td>Offices, Hotels, Hostels, Schools</td>
<td>1</td>
<td>Based on specified requirement</td>
</tr>
</tbody>
</table>

Table B.2. Grades of performance for Innovative methods of building construction

*Note: currently modules intended for residential use only are covered by BPS 7014*
B.4 Time equivalent by calculation (normative)

According to BS EN 1991-1-2, Eurocode 1: Actions on structures – Part 1-2: General actions – Actions on structures exposed to fire, the equivalent time of fire exposure is given by:

\[ t_{e,d} = q_{f,d} \cdot w_f \cdot k_b \]

where:

- \( t_{e,d} \) is time equivalent (min)
- \( q_{f,d} \) is the design fire load density (MJ/m²)
- \( k_b \) is a conversion factor to account for the thermal properties of the compartment lining. Where no detailed assessment of the thermal properties of the enclosure is made, the conversion factor \( k_b \) may be taken as 0.09 (min. m²/MJ)
- \( w_f \) is the ventilation factor in the absence of horizontal openings given by:
  \[ w_f = (6.0/H)^{0.3} \cdot [0.62 + 90(0.4-\alpha_v)^4] \]
- \( H \) is the height of the enclosure (m)
- \( \alpha_v = A_v / A_f \) is the area of vertical openings in the façade \( A_v \) related to the floor area of the compartment \( A_f \) where the limit \( 0.025 \leq \alpha_v \leq 0.25 \) should be observed

B.5 Time equivalent by direct measurement (normative)

Time equivalent may be assessed by comparing the maximum temperature of a protected structural element in a natural fire to the time taken to achieve that temperature in a standard fire test. To this end an instrumented test specimen for which standard test data is available shall be placed in the centre of the fire compartment and the equivalent period assessed based on the recorded data.
### AMENDMENTS ISSUED SINCE PUBLICATION

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<th>DOCUMENT NO.</th>
<th>AMENDMENT DETAILS</th>
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