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Introduction

Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international and European standards, comments will be reviewed by the relevant UK national committee before submitting the consensus UK vote and comments. If the draft standard is approved, it is usual for the resulting published standard to be adopted as a British Standard.

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BS 6229, Flat roofs with continuously supported flexible waterproof coverings – Code of practice

Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on XX Month 2025. It was prepared by Technical Committee B/546, *Flexible Sheets for Waterproofing*. A list of organizations represented on this committee can be obtained on request to the committee manager.

Supersession

This British Standard supersedes BS 6229:2018, which is withdrawn.

Relationship with other publications

This British Standard is intended to be read in conjunction with BS 5250, BS 8000-4 and BS 8233.

Information about this document

This is a full revision of the document, and introduces the following principal changes:

- roof falls to achieve drainage
- thermal performance of inverted roof systems.
- fire performance, including fire classification of roof system.

This publication can be withdrawn, revised, partially superseded or superseded. Information regarding the status of this publication can be found in the Standards Catalogue on the BSI website at bsigroup.com/standards, or by contacting the Customer Services team.

Where websites and webpages have been cited, they are provided for ease of reference and are correct at the time of publication. The location of a webpage or website, or its contents, cannot be guaranteed.

NOTE Guidance on the methodology of condensation risk analysis is now covered by BS 5250, workmanship is now covered by BS 8000-4 and guidance on sound insulation and noise reduction for buildings is now covered in BS 8233.

Use of this document

As a code of practice, this British Standard takes the form of recommendations and guidance. It is not to be quoted as if it were a specification. Users are expected to ensure that claims of compliance are not misleading.

Users may substitute any of the recommendations in this British Standard with practices of equivalent or better outcome. Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this document are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is “should”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Where words have alternative spellings, the preferred spelling of the *Shorter Oxford English Dictionary* is used (e.g. “organization” rather than “organisation”).

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1 Scope

This revised edition of BS 6229 describes best current practice in the design, construction, care and maintenance of roofs with a flat or curved surface, at a pitch not greater than 10 degrees to the horizontal, with a continuously supported flexible waterproof covering. The supporting structure is either dense and heavy (such as a concrete slab), or consists of framing members supporting a lightweight deck of metal or of timber-based material.

NOTE Provided that the design conditions are similar, many of the recommendations contained in this code of practice apply to roofs at pitches greater than 10 degrees and to those designed with multi-functional finishes.

This British Standard does not apply to certain types of cold stores and high temperature enclosures.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Standards publications

BS 1088, *Marine plywood – Requirements*

BS 5250, *Management of moisture in buildings – Code of practice*

BS 6100-6, *Building and civil engineering – Vocabulary – Part 6: Construction parts*

BS 6925, *Specification for mastic asphalt for building and civil engineering (limestone aggregate)*

BS 8103-3, *Structural design of low-rise buildings – Part 3: Code of practice for timber floors and roofs for housing*

BS 8204-1, *Screeds, bases and in situ floorings – Part 1: Concrete bases and cementitious levelling screeds to receive floorings – Code of practice*

BS 8204-2:2003+A2, *Screeds, bases and in situ floorings – Part 2: Concrete wearing surfaces – Code of practice*

BS 8217, *Reinforced bitumen membranes for roofing – Code of practice*

BS 8218, *Code of practice for mastic asphalt roofing*

BS 8220-1, *Guide for security of buildings against crime – Part 1: Dwellings*

BS 8220-2, *Guide for security of buildings against crime – Part 2: Offices and shops*

BS 8220-3, *Guide for security of buildings against crime – Part 3: Storage, industrial and distribution premises*

BS 8233, *Guidance on sound insulation and noise reduction for buildings*

BS 8747, *Reinforced bitumen membranes (RBMs) for roofing – Guide to selection and specification*

BS 9999, *Fire safety in the design, management and use of buildings – Code of practice*

BS EN 300, *Oriented strand boards (OSB) – Definitions, classification and specifications*

BS EN 507, *Roofing products from metal sheet – Specification for fully supported roofing products of aluminium sheet*

BS EN 636, *Plywood – Specifications*

BS EN 1313-1, *Round and sawn timber – Permitted deviations and preferred sizes – Part 1: Softwood sawn timber*

BS EN 1313-2, *Round and sawn timber – Permitted deviations and preferred sizes – Part 2: Hardwood sawn timber*

BS EN 12620:2002+A1:2008, *Aggregates for concrete*

BS EN 1991-1-1, *Eurocode 1 – Actions on structures – Part 1-1: General actions – Densities, self-weight, imposed loads for buildings*

BS EN 1991-1-3, *Eurocode 1 – Actions on structures – Part 1-3: General actions – Snow loads*

BS EN 1991-1-4, *Eurocode 1 – Actions on structures – Part 1-4: General actions – Wind actions*

BS EN 1992-1-1 + UK National Annex, *Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings, bridges and civil engineering structures*

BS EN 1993-1-1 + UK National Annex, *Eurocode 3: Design of steel structures – Part 1-1: General rules and rules for buildings*

BS EN 1994-1-1 + UK National Annex, *Eurocode 4: Design of composite steel and concrete structures – Part 1-1: General rules and rules for buildings*

BS EN 1995-1-1 + UK National Annex, *Eurocode 5: Design of timber structures – Part 1-1: General – Common rules and rules for buildings*

BS EN 1999-1-1, *Eurocode 9: Design of aluminium structures – Part 1-1: General structural rules*

BS EN 1999-1-4, *Eurocode 9 – Design of aluminium structures – Part 1-4: Cold-formed structural sheeting*

BS EN 10346, *Continuously hot-dip coated steel flat products for cold forming – Technical delivery conditions*

BS EN 12056-3, *Gravity drainage systems inside buildings – Part 3: Roof drainage, layout and calculation*

BS EN 12524, *Building materials and products – Hygrothermal properties – Tabulated design values*

BS EN 12620, *Aggregates for concrete*

BS EN 13055-1, *Lightweight aggregates – Part 1: Lightweight aggregates for concrete, mortar and grout*

BS EN 13108-6, *Bituminous mixtures – Part 6: Material specifications – Mastic Asphalt*

BS EN 13162, *Thermal insulation products for buildings – Factory made mineral wool (MW) products – Specification*

BS EN 13163, *Thermal insulation products for buildings – Factory made expanded polystyrene (EPS) products – Specification*

BS EN 13164, *Thermal insulation products for buildings – Factory made extruded polystyrene foam (XPS) products – Specification*

BS EN 13165, *Thermal insulation products for buildings – Factory made rigid polyurethane foam (PU) products – Specification*

BS EN 13166, *Thermal insulation products for buildings – Factory made phenolic foam (PF) products – Specification*

BS EN 13167, *Thermal insulation products for buildings – Factory made cellular glass (CG) products – Specification*

BS EN 13169, *Thermal insulation products for buildings – Factory made expanded perlite board (EPB) products – Specification*

BS EN 13170, *Thermal insulation products for buildings – Factory made products of expanded cork (ICB) – Specification*

BS EN 13707, *Flexible sheets for waterproofing – Reinforced bitumen sheets for roof waterproofing – Definitions and characteristics*

BS EN 13859-1, *Flexible sheets for waterproofing – Part 1: Definitions and characteristics of underlays – Part 1: Underlays for discontinuous roofing*

BS EN 13956, *Flexible sheets for waterproofing – Plastic and rubber sheets for roof waterproofing – Definitions and characteristics*

BS EN 13970, *Flexible sheets for waterproofing – Bitumen water vapour control layers – Definitions and characteristics*

BS EN 13984, *Flexible sheets for waterproofing – Plastic and rubber vapour control layers – Definitions and characteristics*

BS EN 13986:2004+A1:2015, *Wood-based panels for use in construction – Characteristics, evaluation of conformity and marking*

BS EN 16002, *Flexible sheets for waterproofing – Determination of the resistance to wind load of mechanically fastened flexible sheets for roof waterproofing*

BS EN ISO 6946, *Building components and building elements – Thermal resistance and thermal transmittance – Calculation methods*

BS EN ISO 10211, *Thermal bridges in building construction – Heat flows and surface temperatures – Detailed calculations*

BS EN ISO 10456, *Building materials and products – Hygrothermal properties – Tabulated design values and procedures for determining declared and design thermal values*

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*

DD CEN/TS 1099, *Plywood – Biological durability – Guidance for the assessment of plywood for use in different use classes*

DD ENV 1992-1-1, *Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings (together with United Kingdom National Application Document)*

Other publications

[N1] The Building Regulations (England and Wales) 2000, Approved Documents L1 and L2 2013 with 2016 amendments. London: The Stationery Office. www.tso.co.uk

[N2] EUROPEAN ORGANISATION FOR TECHNICAL ASSESSMENT. *Guidelines for European Technical Approval of Inverted Roof Insulation Kits*. ETAG 031-1. EOTA www.eota.eu

[N3] BRITISH BOARD OF AGREEMENT. BBA Information No 4, *Inverted roofs – Drainage and U value calculations*

[N4] The Building Regulations 2010, *Site preparation and resistance to contaminants and moisture*, Approved Document C [England]

[N5] The Building Regulations 2010 (and 2012 amendments), *Site preparation and resistance to contaminants and moisture*, Approved Document C [Wales]

[N6] Technical Handbook 6, Clause 6.2.1 [Scotland]

- [N7] Technical Booklets F1 and F2, Table 2.3 [Northern Ireland]
- [N8] Building Bulletin 93 (BB93) *Acoustic Design of Schools - Performance Standards*
- [N9] CONSTRUCTION INDUSTRY RESEARCH AND INFORMATION ASSOCIATION. CIRIA Report 127, *Sound Control for Homes*
- [N10] *The Building Regulations (England and Wales) 2010*. Approved Document B (Fire Safety) – Volume 2: Buildings other than dwellinghouses (2006 edition incorporating 2010 and 2013 amendments). London: The Stationery Office. www.tso.co.uk
- [N11] NATIONAL FEDERATION OF ROOFING CONTRACTORS (NFRC). *Safe2Torch Guidance for the safe installation of torch-on reinforced bitumen membranes and use of gas torches in the workplace*.
- [N12] BUILDING RESEARCH ESTABLISHMENT. *Wind scour of ballast on roofs*. 1986. BRE Digest 311 (DG 311). Watford: BRE. www.brebookshop.com
- [N13] MASTIC ASPHALT COUNCIL (MAC). *Mastic asphalt - The technical guide*. The Mastic Asphalt Council. www.masticasphaltcouncil.co.uk
- [N14] SINGLE PLY ROOFING ASSOCIATION (SPRA). *Guide on design criteria for single ply roofing membranes*. London: The Single Ply Roofing Association. www.spra.co.uk
- [N15] LIQUID ROOFING AND WATERPROOFING ASSOCIATION (LRWA). *Code of practice for the specification and use of liquid applied waterproofing systems for Roofs, Balconies and Walkways*. August 2018. LRWA Guidance notes can be found at: www.lrwa.org.uk
- [N16] EUROPEAN ORGANISATION FOR TECHNICAL ASSESSMENT. *Liquid applied roof waterproofing kits – Parts 1–8*. ETAG 005. EOTA www.eota.eu
- [N1] EUROPEAN ORGANISATION FOR TECHNICAL ASSESSMENT. *Vacuum insulation panels (VIP) with Factory Applied Protection layers*. EAD 040011-00-1201. 2017.

3 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS 6100-6 and the following apply:

3.1 breather membrane

continuous layer of highly vapour permeable, but air impermeable, material to permit the movement of water vapour in cold roof constructions

NOTE The level of vapour permeability required is defined in BS 5250.

3.2 condensation

conversion of water vapour to liquid water

3.2.1 condensate

liquid water produced by condensation

3.2.2 harmful condensation

interstitial or surface condensation likely to cause damage to the building fabric, to degrade its thermal performance or to support mould

3.2.3 interstitial condensation

condensation which occurs within or between layers of a roof system

3.2.4 surface condensation

condensation which occurs on surfaces visible within the building

3.3 dew point

temperature at which air becomes saturated with water vapour and condensation occurs

3.4 firrings

battens intended to provide drainage falls or ventilation of a roof void

3.5 lap

overlapping edges of roofing membranes which join together or connect to adjacent material.

NOTE It could be a side or end lap.

3.6 layers

3.6.1 air and vapour control layer (AVCL)

continuous layer of low permeability material to control the movement of air and water vapour

NOTE Formerly referred to as VCL in BS 6229:2003.

3.6.2 waterproof layer

layer of impermeable flexible membrane applied either as a factory manufactured sheet or in liquid form

3.6.3 water flow reducing layer (WFRL)

robust vapour permeable layer to restrict the flow of water in an inverted roof system

NOTE It also prevents fines from being washed below the insulation, which can damage the waterproofing system or block the roof drainage system.

3.7 liquid applied membrane systems

3.8 multi-functional finishes

the upper most surface of a flat roof (including a terrace or podium) serving multiple purposes beyond a primary waterproofing function, incorporating elements for accessibility, biodiversity, attenuation, recreation, sustainability, energy generation, environmental improvement, climate resilience, and/or aesthetic enhancement

3.9 podium

structural slab or deck, either below ground level, at ground level, or supported on columns over a heated, partially heated, or unheated space, which provides an external amenity space incorporating hard and/or soft landscaping.

NOTE Podiums usually cover large areas and might also serve as a platform for additional buildings.

3.10 ponding

standing water not able to drain from a flat roof because of poor design, insufficient roof slope, support structure deflection and construction tolerance

3.11 roofs

3.11.1 absolute zero gradient/fall roof

blue roofs designed to a zero gradient/fall with a finished surface deviation no greater than 5mm over 2m under maximum load

3.11.2 blue roof

roof designed to attenuate the rate at which rainwater is drained from the roof and is allowed to enter the drainage system, typically installed beneath a green roof, roof garden, paving or ballast

3.11.3 flat roof

roof with a weathered surface at no more than ten degrees (10°) to the horizontal

3.11.4 green roof (extensive and biodiverse)/roof garden (intensive)

roof on which vegetation or a habitat for wildlife is established

NOTE These can be installed over warm, inverted and uninsulated flat roof constructions.

3.11.5 zero fall roof

roofs with a slope which lies between 0 and 1:80 with a finished surface deviation no greater than 8mm over 2m under maximum load

3.12 support(ing) structure

layer of material supported by beams, trusses and/or load-bearing walls to provide structural support to the waterproof layer; other layers depending upon the type of flat roof system; optional surface

protection; growing media on green roofs; attenuated rainwater on blue roofs; free-standing roof-mounted plant; photovoltaic arrays; and other dead and live loads

NOTE The support(ing) structure might also resist wind uplift acting on the waterproof layer and other layers depending upon their method(s) of attachment.

3.12.1 roof deck

support structure of profiled metal or timber

3.12.2 roof slab

support structure of in situ or pre-cast concrete

3.13 root resistant material

membrane that permanently protects the roof's waterproof covering by preventing plant roots or rhizomes from growing into or through it

3.14 tapered insulation

insulation of varying thickness to create or augment drainage falls

3.15 thermal bridge (cold bridge)

part of a roof with thermal resistance significantly lower than that of the surrounding construction

3.16 water check

lap build ups in the waterproof layer delaying drainage resulting in temporary non-detrimental water pooling

4 Design

4.1 General design considerations

COMMENTARY ON 4.1

The roof of any building is required to separate a controlled internal environment from the external climate: therefore it contains layers to control the movement of rainwater, heat, fire, air, vapour and sound. A roof might also be required to provide a certain level of security.

Depending upon the type of building, the degree of security required and the loads to be supported, the basic structure of a flat roof might either be a heavy reinforced concrete slab or a relatively lightweight deck on supporting beams.

Lightweight decks of plywood or profiled metal, which can be readily cut or prised open, offer a lesser barrier than a concrete slab to attempted illegal entry; such roof systems should not be used on buildings which require a high standard of security.

The slab or deck should provide continuous support to a waterproof layer either directly or via a layer of thermal insulation. It might incorporate an air and vapour control layer (AVCL), ceiling, screed, surface paving or reflective treatment, rooflights, vents and attachments such as handrails, gantry rails, fall arrest posts and lightning conductors.

It is essential that the waterproof layer remains imperforate, and that the thermal insulation should not provide less than the degree of thermal resistance demanded by regulation relevant to the building use, whilst the air/vapour controlling layer(s) regulates the movement of air and the transport of water vapour.

The design of a flat roof should take full account of factors likely to have an adverse effect on the performance of the roof construction during the design life of the roof.

Early assessment of the compatibility of materials should be carried out, especially those used for critical interfaces.

When membrane systems of different types are brought together, including where adhesive bonding is required, the materials supplied by all parties should be checked for compatibility, including testing, to prevent early degradation of materials and performance of the bonded joint.

NOTE 1 Of primary concern is the risk of physical damage to the waterproof layer and of damaging condensation within or between the layers of construction, including at perimeters and detail penetrations.

NOTE 2 Physical damage can be caused by environmental factors, fire, traffic on the roof, movement of the building structure and by differential movements between layers resulting from variations in temperature or moisture content.

NOTE 3 Harmful condensation might form on, or between, layers of roof construction as a result of air-borne moisture or water vapour movement through the layers meeting a surface at or below dew point temperature (see 3.4).

NOTE 4 Waterproofing is not a structural element. During the design process, there is a need to assess if it is suitable to build walls directly off the waterproofing system. Further information is given in "Guidance Note No. 16 - Walls Built onto Waterproofing Systems" (LRWA) [6].

4.2 Types of flat roof system

COMMENTARY ON 4.2

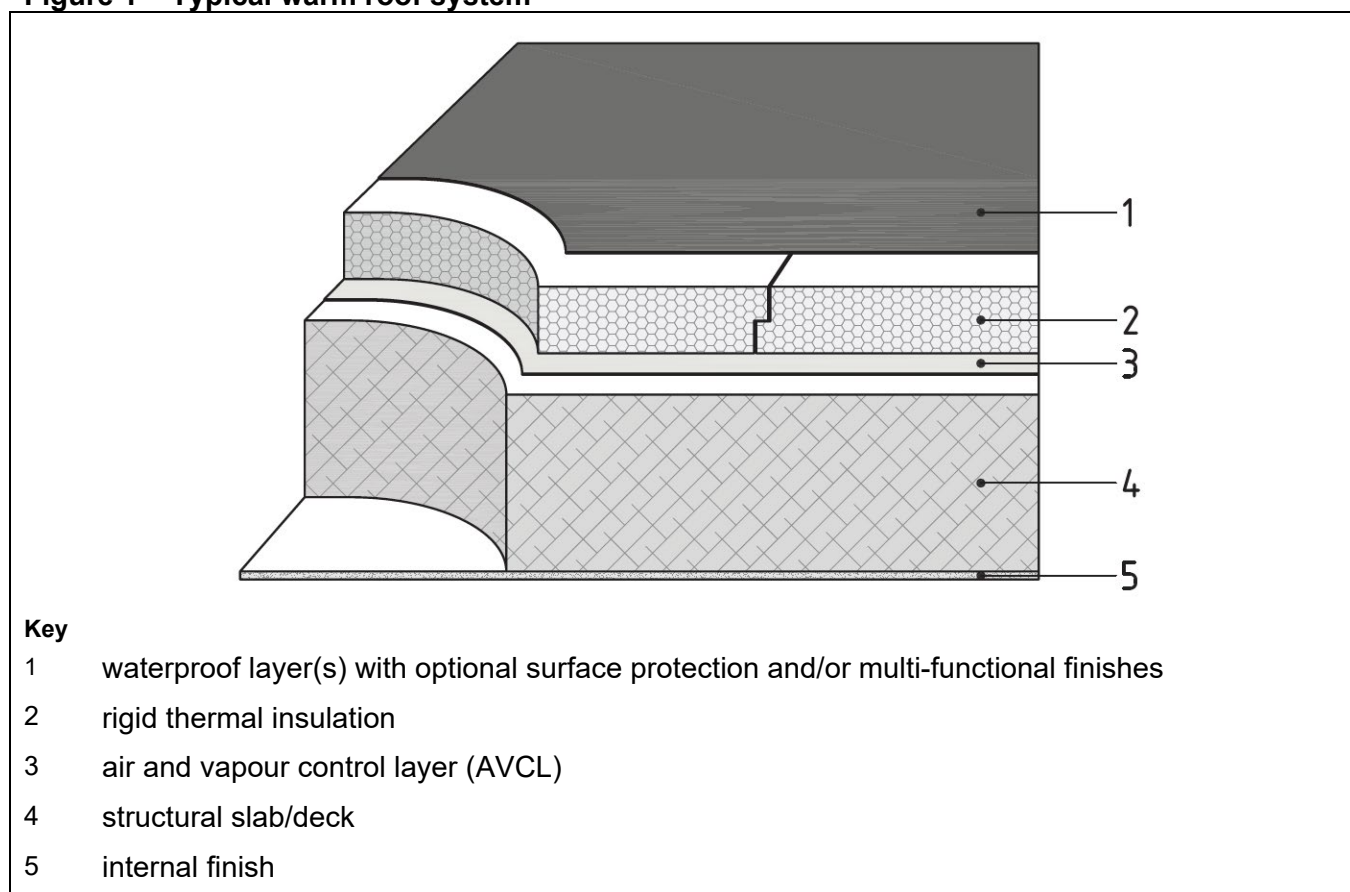
Flat roof constructions are defined according to the location of the principal thermal insulation and its consequent effect upon the temperature of the roof slab or roof deck.

4.2.1 Warm roof system

COMMENTARY ON 4.2.1

In a warm roof system the principal thermal insulation is placed above the slab/deck, resulting in the temperature of that slab/deck being close to that of the building interior (see Figure 1).

Figure 1 – Typical warm roof system



NOTE 1 This is the most widely used type of flat roof; it is suitable for most building types and hospitals.

The insulation should be in the form of tightly butted rigid boards able to sustain all intended loads over the working life of the roof system; they might be square edge boards, ideally in a staggered joint multi-layer or single layer with overlapping or interlocking edges in order to minimize thermal bridging, with overlapping or interlocking edges.

To minimize the risk of interstitial condensation and prevent any annual accumulation, the design should include that an air and vapour control layer (AVCL) with an appropriate vapour resistance be installed with sealed laps to the abutments and penetrations, on the warm side of the insulation where it can also control air and heat leakage from within the building (see 4.7.3).