

Flat roofs with continuously supported coverings — Code of practice

ICS 91.060.20

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by Technical Committee B/209, General building codes, to Subcommittee B/209/1, Flat roofs, upon which the following bodies were represented:

- Association of Building Component Manufacturers (ABCM)
- Association of British Roofing Felt Manufacturers (ABRFM)
- Aluminium Federation
- BRE Certification
- BRE/LPC Laboratories
- Building Research Establishment (BRE)
- British Rigid Urethane Foam Manufacturers Association (BRUFMA)
- Copper Development Association (CDA)
- Cork Industry Federation
- Eurisol (UK Mineral Wood Association)
- European Liquid Roofing Association (ELRA)
- Flat Roofing Alliance — Contractors (FRA)
- Flat Roofing Alliance — Manufacturers (FRA)
- Institute of Structural Engineers
- Lead Sheet Association (LSA)
- Local Authority Organizations
- Mastic Asphalt Council Ltd. (MAC)
- National Federation of Roofing Contractors (NFRC)
- Royal Institute of British Architects (RIBA)
- Scottish Office (Construction and Building)
- Single Ply Roofing Association (SPRA)
- Thermal Insulation Manufacturers and Suppliers Association (TIMSA)
- Wood Panel Industries Federation (WPIF)

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Foreword

This British Standard code of practice has been prepared by Technical Committee B/209/1. It supersedes BS 6229:1982, which is withdrawn.

This code of practice deals with the overall principles of design and application of flat roofs with continuously supported roof coverings. A flat roof is defined as having a pitch not greater than 10° to the horizontal.

Where the particular use of individual materials or forms of construction is covered by other, specific codes of practice, detailed reference should additionally be made to the normative references in Clause 2.

Since publication of the first edition of this code of practice (1982), many changes have taken place in the functional requirements for buildings, in the performance capability of many roofing materials and in some aspects of building practice. The original code of practice has, therefore, undergone a comprehensive review and updating.

Extensive guidance on the analysis of condensation risks in flat roof construction was given in the first edition of this code of practice. Guidance on the methodology of condensation risk analysis is now covered by BS 5250. Specific guidance on criteria and assumptions that are relevant to flat roof construction are retained in this revision of this code of practice.

The 1982 edition of this British Standard dealt with both design and workmanship. Workmanship is now covered by BS 8000-2.2, -3, -4, -5, and -9.

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

NOTE It has been assumed in the drafting of this code of practice that the design and construction of flat roofs is entrusted to appropriately qualified and competent people. It has also been assumed that the building owner will adopt the recommendations in respect of planned inspection and maintenance of a roof during service.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Attention is drawn to the following statutory regulations relating to construction safety (see also Clause 20): The Construction (General Provisions) Regulations 1961 [1], The Construction (Lifting Operations) Regulations 1998 [2], The Construction (Notice of Accident, etc.) Orders 1964 [3], The Construction (Working Places) Regulations 1966 [4], The Construction (Health, Safety and Welfare) Regulations 1996 [5], Health and Safety at Work etc. Act 1974 [6].

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 37 and a back cover.

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1 Scope

This code of practice gives recommendations on the design and application of flat roofs with continuously supported roof coverings. It covers weathertightness, drainage, thermal design, sound insulation, condensation control, structural support, fire precautions, maintenance and repair. The recommendations are applicable to terraces, podia, parking decks and green/garden roofs; however these particular types of roof also require consideration of additional factors, beyond the scope of this code of practice.

This code of practice is applicable to roof coverings at a pitch not greater than 10° to the horizontal.

NOTE Provided that the design conditions are similar, the recommendations given in this code may also be applied to roofs with slopes greater than 10°, but for steep roofs many of the recommendations may not apply.

This code of practice does not apply to roofs with self-supporting coverings, cold stores and high temperature enclosures, or to slated or tiled roofs.

2 Normative references

The following referenced documents are indispensable for the application 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.

BS 476-3:1958 (document withdrawn), *Fire tests on building materials and structures — Part 3: External fire exposure roof test*. See BS 5427-1:1996, *Code of practice for the use of profiled sheet for roof and wall cladding on buildings — Part 1: Design*.¹⁾

BS 476-6, *Fire tests on building materials and structures — Part 6: Method of test for fire propagation for products*.

BS 476-7, *Fire tests on building materials and structures — Part 7: Method of test to determine the classification of the surface spread of flame of products*.

BS 476-21, *Fire tests on building materials and structures — Part 21: Methods for determination of the fire resistance of load-bearing elements of construction*.

BS 747, *Reinforced bitumen sheets for roofing — Specification*.

BS 882-2, *Specification for aggregates from natural sources for concrete*.

BS 1105, *Specification for wood wool cement slabs up to 125 mm thick*.

BS 2782-1, *Methods of testing plastics — Part 1: Thermal properties*.

BS 3797, *Specification for lightweight aggregates for structural concrete*.

BS 3837-1, *Expanded polystyrene boards — Part 1: Specification for boards manufactured from expandable beads*.

BS 3837-2, *Expanded polystyrene boards — Part 2: Specification for extruded polystyrene boards (XPS)*.

BS 3927, *Specification for rigid phenolic foam (PF) for thermal insulation in the form of slabs and profiled sections*.

BS 3958-5, *Thermal insulating materials — Part 5: Specification for bonded man-made mineral fibre slabs*.

BS 4841-3, *Rigid polyurethane (PUR) and polyisocyanurate (PIR) foam for building applications — Part 3: Specification for roofboards*.

BS 5241-1, *Rigid polyurethane (PUR) and polyisocyanurate (PIR) foam when dispensed or sprayed on a construction site — Part 1: Specification for sprayed foam thermal insulation applied externally*.

BS 5250, *Code of practice for control of condensation in buildings*.

BS 5268-2, *Structural use of timber — Part 2: Code of practice for permissible stress design, materials and workmanship*.

BS 5268-5, *Structural use of timber — Part 5: Code of practice for the preservative treatment of structural timber*.

¹⁾ A review of DD ENV 1187:2002, *Test methods for external fire exposure to roofs*, will be initiated after 2 years and once completed will supersede the BS 476-3:1958 test given in BS 5427-1:1996, Annex E.

BS 5268-7.2, *Structural use of timber— Part 7: Recommendations for the calculation basis for span tables — Section 7.2: Joists for flat roofs.*

BS 5427-1:1996, *Code of practice for the use of profiled sheet for roof and wall cladding on buildings — Part 1: Design.*

BS 5588 (all parts), *Fire precautions in the design, construction and use of buildings.*

BS 5720, *Code of practice for mechanical ventilation and air conditioning in buildings.*

BS 5925, *Code of practice for design of buildings — Ventilation principles and designing for natural ventilation.*

BS 5950-6, *Structural use of steelwork in building — Part 6: Code of practice for design of light gauge profiled steel sheeting.*

BS 6100-1.3.2, *Glossary of building and civil engineering terms — Part 1: General and miscellaneous — Section 1.3: Parts of construction works — Subsection 1.3.2: Roofs and roofing.*

BS 6180, *Barriers in and about buildings — Code of practice.*

BS 6399-1, *Loading for buildings — Part 1: Code of practice for dead and imposed loads.*

BS 6399-2, *Loading for buildings — Part 2: Code of practice for wind loads.*

BS 6399-3, *Loading for buildings — Part 3: Code of practice for imposed roof loads.*

BS 6651, *Code of practice for protection of structures against lightning.*

BS 6915, *Design and construction of fully supported lead sheet roof and wall coverings — Code of practice.*

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

BS 7021, *Code of practice for thermal insulation of roofs externally by means of sprayed rigid polyurethane (PUR) or polyisocyanurate (PIR) foam.*

BS 7916, *Code of practice for the selection and application of particleboard, oriented strand board (OSB), cement bonded particleboard and wood fibreboards for specific purposes.*

BS 8110 (all parts), *Structural use of concrete.*

BS 8118-1, *Structural use of aluminium — Part 1: Code of practice for design.*

BS 8118-2, *Structural use of aluminium — Part 2: Specification for materials, workmanship and protection.*

BS 8204-1, *Screeds, bases and in-situ floorings — Part 1: Concrete bases and cement sand levelling screeds to receive floorings — Code of practice.*

BS 8206-2, *Lighting for buildings — Part 2: Code of practice for daylighting.*

BS 8217, *Code of practice for built-up felt roofing.*

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: Warehouses and distribution units.*

BS 8233, *Sound insulation and noise reduction for buildings — Code of practice.*

BS 8290-1, *Suspended ceilings — Part 1: Code of practice for design.*

CP 143-5, *Code of practice for sheet roof and wall coverings — Part 5: Zinc.*

CP 143-12, *Code of practice for sheet roof and wall coverings — Part 12: Copper: Metric units.*

CP 143-15, *Code of practice for sheet roof and wall coverings — Part 15: Aluminium: Metric units.*

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

BS EN 312-5, *Particleboards — Specifications — Part 5: Requirements for load-bearing boards for use in humid conditions.*

BS EN 312-7, *Particleboards — Specifications — Part 7: Requirements for heavy-duty load-bearing boards for use in humid conditions.*

BS EN 314-2, *Plywood — Bonding quality — Part 2: Requirements.*

- BS EN 336, *Structural timber — Coniferous and poplar — Sizes — Permissible deviations.*
- BS EN 485 (all parts), *Aluminium and aluminium alloys — Sheet, strip and plate.*
- BS EN 501, *Roofing products from metal sheet — Specifications for fully supported roofing products of zinc sheet.*
- BS EN 502, *Roofing products from metal sheet — Specification for fully supported roofing products of stainless steel sheet.*
- BS EN 504, *Roofing products from metal sheet — Specification for fully supported roofing products of copper sheet.*
- BS EN 507, *Roofing products from metal sheet — Specification for fully supported roofing products of aluminium sheet.*
- BS EN 622-4, *Fibreboards — Specifications — Part 4: Requirements for softboards.*
- BS EN 634-2, *Cement-bonded particle boards — Specification — Part 2: Requirements for OPC bonded particleboards for use in dry, humid and exterior conditions.*
- BS EN 636-2, *Plywood — Specifications — Part 2: Requirements for plywood for use in humid conditions.*
- BS EN 636-3, *Plywood — Specifications — Part 3: Requirements for plywood for use in exterior conditions.*
- BS EN 1172, *Copper and copper alloys — Sheet and strip for building purposes.*
- BS EN 1313-1, *Specification for sizes of sawn and processed — Part 1: Softwood.*
- BS EN 10258, *Cold-rolled stainless steel narrow strip and cut lengths — Tolerances on dimensions and shape.*
- 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 12588, *Lead and lead alloys — Rolled lead sheet for building purposes.*
- 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 products of expanded polystyrene — Specification.*
- BS EN 13164, *Thermal insulation products for buildings — Factory made products of extruded polystyrene foam (XPS) — Specification.*
- BS EN 13165, *Thermal insulation products for buildings — Factory made rigid urethane foam (PUR) products — Specification.*
- BS EN 13166, *Thermal insulation products for buildings — Factory made products of phenolic foam — Specification.*
- BS EN 13167, *Thermal insulation products for buildings — Factory made cellular glass (CG) products — Specification.*
- BS EN 13168, *Thermal insulation products for buildings — Factory made wood wool (WW) products — Specification.*
- BS EN 13169, *Thermal insulation products for buildings — Factory made products of expanded perlite — Specification.*
- BS EN 13170, *Thermal insulation products for buildings — Factory made products of compressed corkboard — Specification.*
- BS EN ISO 140-4, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 4: Field measurements of airborne sound insulation between rooms.*
- BS EN ISO 140-5, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 5: Field measurements of airborne sound insulation of facade elements and facades.*
- BS EN ISO 10456, *Building materials and products — Procedures for determining declared and design thermal values.*

DD ENV 1099, *Plywood — Biological durability — Guidance for the assessment of plywood for use in different hazard classes*.

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

DD ENV 1993-1-1, *Eurocode 3: Design of steel structures — Part 1.1: General rules and rules for buildings (together with United Kingdom National Application Document)*.

DD ENV 1995-1-1, *Eurocode 5: Design of timber structures — Part 1.1: General rules and rules for buildings (together with United Kingdom National Application Document)*.

3 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS 6100-1.3.2 and the following apply.

3.1

flat roof

roof having a pitch not greater than 10° to the horizontal

3.2

condensation

process whereby water is deposited from air containing water vapour, when its temperature drops to or below dew point

3.3

interstitial condensation

condensation occurring within or between the layers of the building envelope

3.4

surface condensation

condensation occurring on visible surfaces within the building

3.5

harmful condensation

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

3.6

cricket

tapered insulation wedge, usually thin, designed to promote flow along a parapet edge or flat gutter line, or around obstacles such as a rooflight kerb, to reduce or prevent standing water (ponding)

NOTE The term “cricket” is usually used in the plural.

3.7

tapered insulation

thermal insulation boards of varying starting thickness, designed and pre-cut or pre-formed to create or augment drainage falls when laid in a prescribed pattern

3.8

thermal bridge

cold bridge

part of a roof of lower thermal resistance than its surrounding elements, which may result in localized cold surfaces on which condensation, mould growth or staining may occur

3.9

vapour control layer (VCL)

construction material (usually a membrane) that substantially reduces the transfer of water vapour through the roof

NOTE The performance of a vapour control layer is dependent upon the material, workmanship and buildability.

3.10

waterproofing system

assembly of one or more layers of roofing sheet in an applied and/or jointed form, with the purpose of preventing the entry or passage of water to the interior of the building

NOTE 1 A bituminous roofing system is formed on site by connecting and sealing one or more superimposed layers of bitumen sheets, to form a single composite waterproof layer for use over flat, pitched or vertical surfaces according to building application requirements.

NOTE 2 Where only one layer is used, this is usually referred to as a single-layer system.

4 Types of flat roof

4.1 General

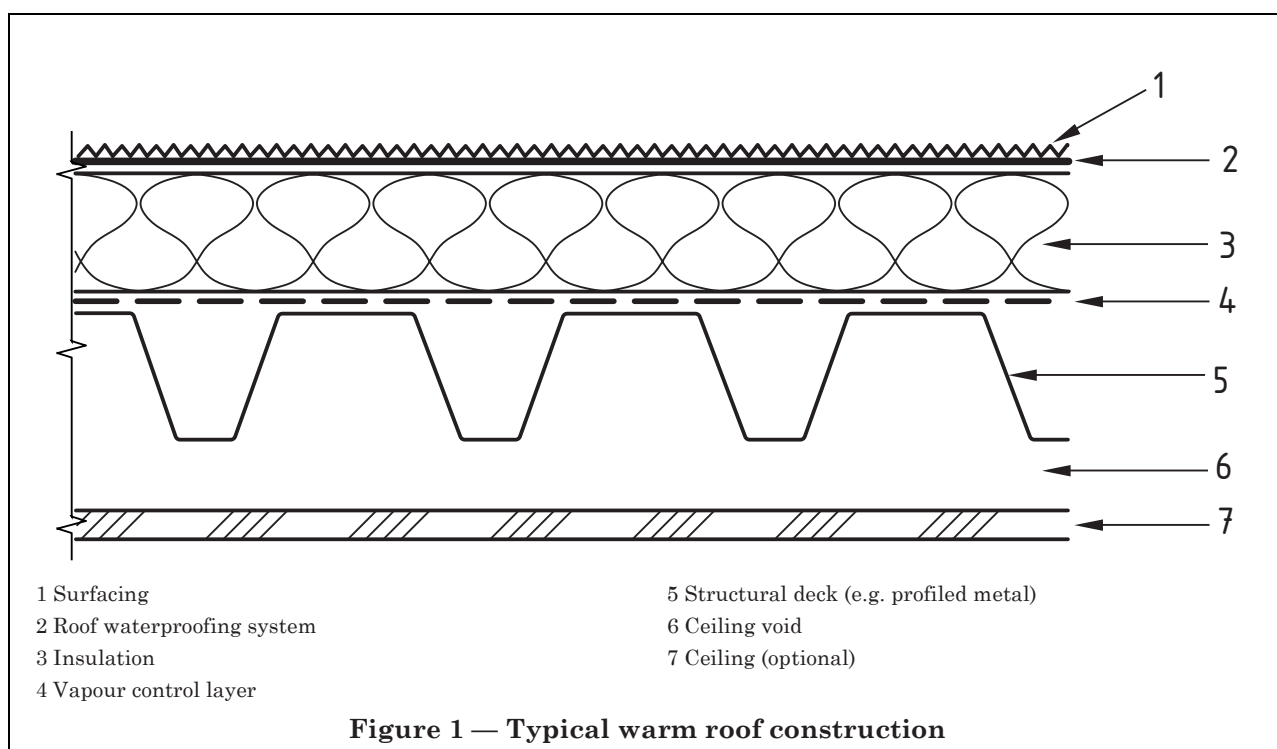
A flat roof is typically a multi-layer construction of roof covering, thermal insulation and structural deck, incorporating drainage outlets and gutters. In addition, it may incorporate vapour control layers, screeds, surface paving, surface reflective treatment, rooflights, ventilators, ceiling materials and attachments such as handrails, gantry rails and lightning conductors.

4.2 Principal types

Flat roof constructions are generally divided into the following types, according to the position in which the principal thermal insulation is placed (see Figure 1, Figure 2 and Figure 3).

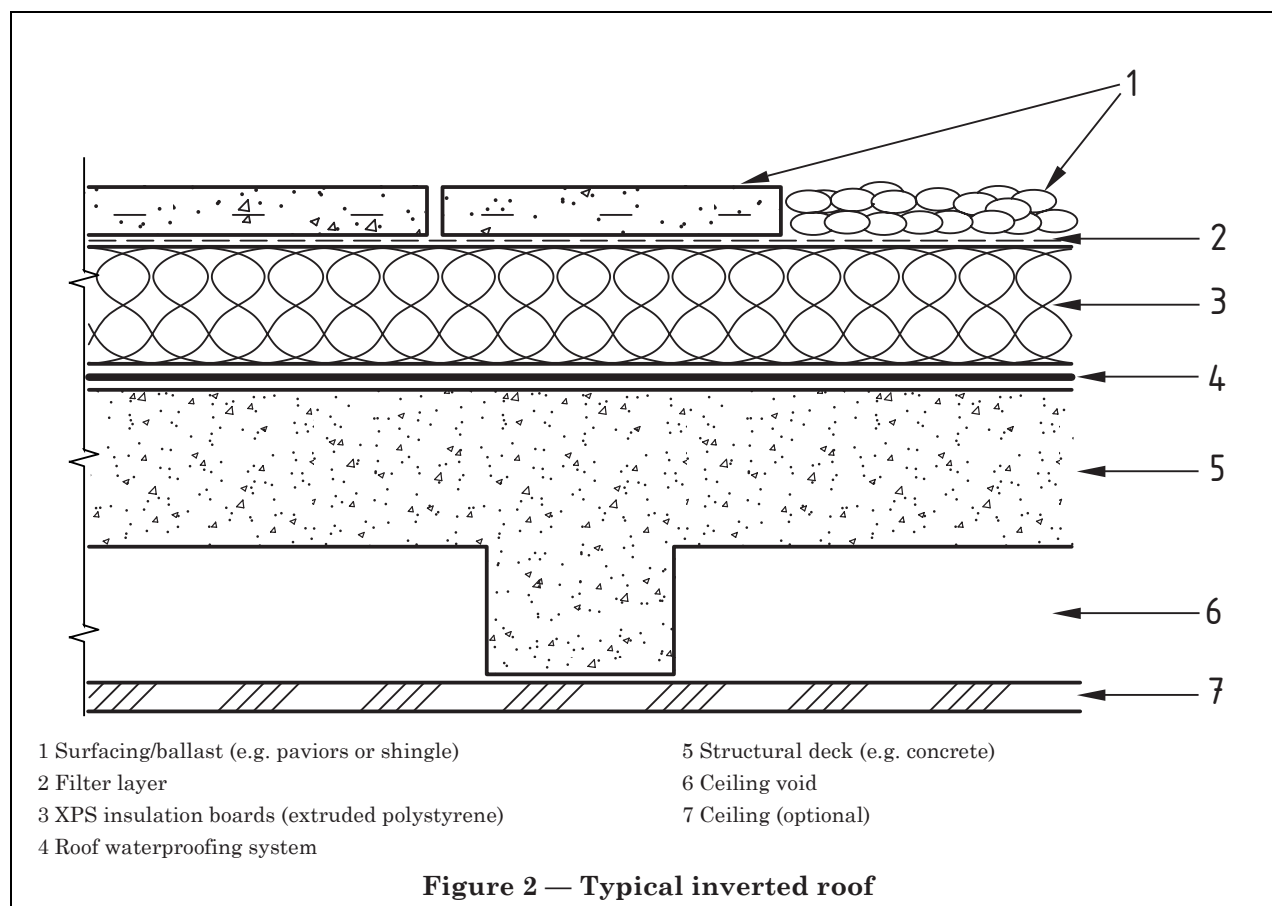
a) The warm roof

The principal thermal insulation is placed above the deck and a vapour control layer and immediately below the roof covering, resulting in the structural deck and ceiling being at a temperature close to that of the interior of the building (see Figure 1).



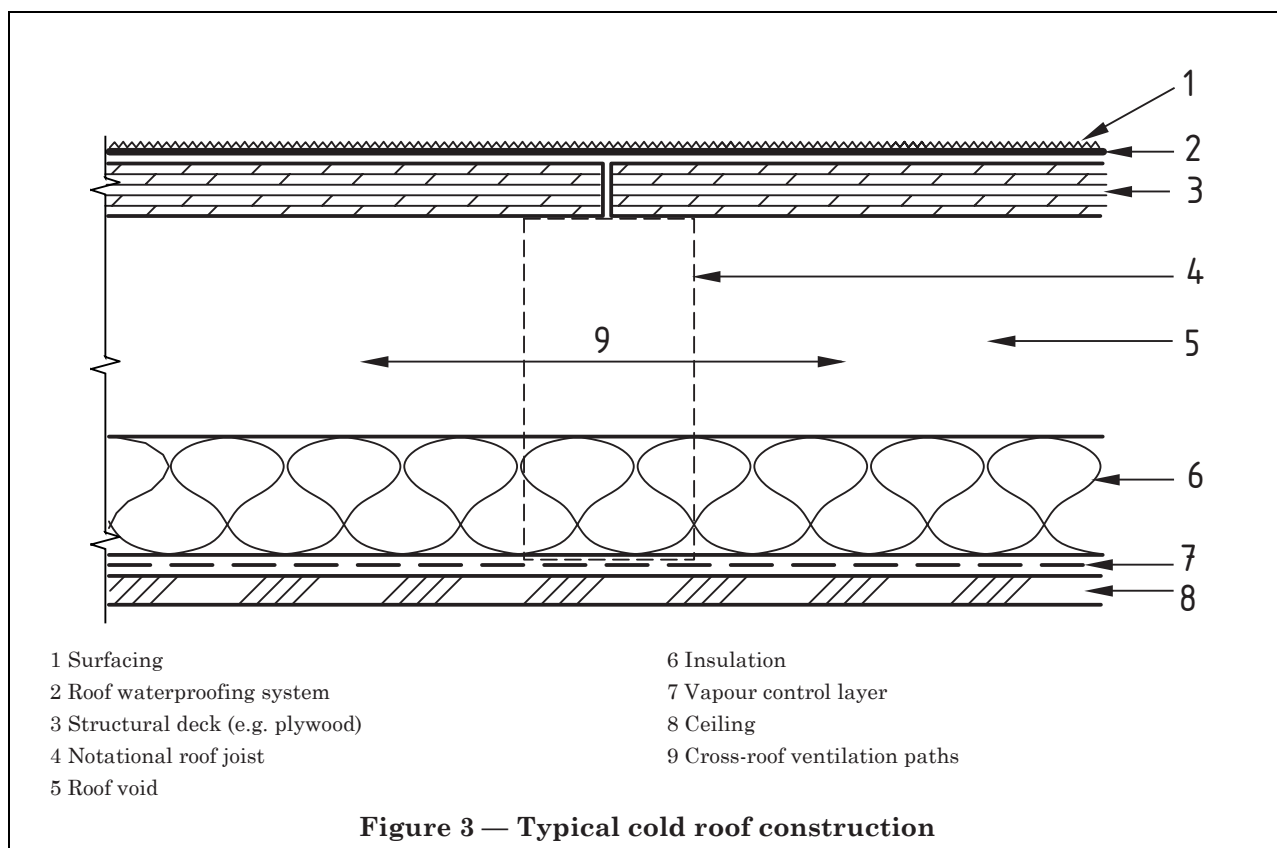
b) The inverted roof

The principal thermal insulation is placed above the roof covering, resulting in the roof covering, structural deck and ceiling being at a temperature close to that of the interior of the building. Generally the principal insulation is secured by ballast, however proprietary lightweight systems are available which do not rely on ballast (see Figure 2).



c) The cold roof

The principal thermal insulation is placed at or immediately above the ceiling, resulting in the roof covering and structural deck being substantially colder in winter than the interior of the building (see Figure 3).



4.3 Other types

Some flat roofs combine the features of two or more of the roof types described in 4.2 a) to c). Examples include structural decks with high thermal insulating properties combined with additional insulation, existing roofs to which thermal insulation is added, and constructions in which the waterproofing layer is sandwiched between two layers of insulation. This form of construction is generally known as a duo roof.

Certain types of metal roof covering (e.g. aluminium, lead and zinc) require ventilation of the underside of the sheeting to the outside air, to reduce the risk of condensation and corrosion. This type of roof design, which is generally known as a ventilated warm roof, combines the principle of a cold roof for the metal sheet and its support layer with that of a warm roof for the main structural deck.

The material supplier should be consulted for specific requirements.

5 Materials and components

5.1 General

Materials and components for flat roofs should conform to the relevant specifications, codes of practice and other guidance documents given in Table 1, Table 2, Table 3, Table 4, Table 5 and Table 6.

NOTE For certain materials and components, guidance on performance and suitability for use in particular conditions is available from European Technical Approval bodies, such as the British Board of Agrément²⁾ or BRE Certification³⁾.

A number of proprietary products are available, such as composite structural decking including integral insulation and/or vapour control layer, and insulated rainwater outlets. These products should be assessed on an individual basis before use.

5.2 Roof coverings

Roof coverings should conform to the relevant specifications or other guidance documents, as given in Table 1, and be fitted in accordance with the recommendations given in the related codes of practice.

Table 1 — Materials for roof coverings

Material	Specification	Code of practice	Other guidance
Lead	BS EN 12588	BS 6915	LSA Handbooks [7]
Zinc	BS EN 501	CP 143-5	—
Stainless steel	BS EN 502 BS EN 10258	— ^a	—
Copper	BS EN 504 BS EN 1172	CP 143-12	CDA Handbook [8]
Aluminium	BS EN 485 BS EN 507	CP 143-15	—
Flexible bitumen sheets	BS 747	BS 8217	FRA Handbook [9]
Mastic asphalt	BS 6925	BS 8218	MAC Technical Guide [10]
Single ply membranes	— ^a	— ^a	SPRA Design Guide [11]
Liquid waterproofing systems (hot- or cold-applied)	— ^a	— ^a	ELRA Code of Practice [12]
^a No British Standards currently exist for these materials.			

²⁾ British Board of Agrément, P.O. Box 195, Bucknalls Lane, Garston, Watford, Herts WD25 9BA. www.bbacerts.co.uk.

³⁾ BRE Certification, Garston, Watford, Herts WD25 9XX. www.bre.co.uk.

5.3 Structural deck

Materials for structural decks should conform to the relevant standards, and where appropriate, to the recommendations given in the related codes of practice shown in Table 2.

Table 2 — Structural deck materials

Materials	Specification or code of practice
Aluminium (profiled)	BS 8118-1 BS 8118-2
Cement bonded particleboard	BS EN 634-2 BS 7916
Concrete	BS 8110 DD ENV 1992-1-1
Oriented strand board	BS EN 300 BS 7916
Particle boards	BS EN 312-5 BS EN 312-7 BS 7916
Plywood	BS EN 314-2 BS EN 636-2 BS EN 636-3 BS 5268-2 DD ENV 1099
Sawn and processed timber	BS EN 1313-1 BS EN 336
Steel (profiled)	BS 5950-6 DD ENV 1993-1-1 ^a
Timber	BS 5268-2 DD ENV 1995-1-1 BS 5268-5, for preservative treatments BS 5268-7.2, for spanning tables
Woodwool slabs	BS 1105
NOTE Proprietary composite decking systems are available, comprising a plywood upper layer, a rigid urethane foam or similar insulation as the core, and commonly incorporating a lower face of reinforced aluminium foil. This foil can form a rudimentary vapour check.	
Generally, their installation method is the same as for plywood decking but their additional thickness entails much longer fixings. As no British Standard currently exists covering these materials, the manufacturer's advice should be followed.	
^a Some profiled metal roofing sheets may not be suitable for decking.	