

Code of practice for

Built-up felt roofing —

(Formerly CP 144-3)

Committees responsible for this British Standard

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- Association of British Roofing Felt Manufacturers
- British Board of Agrément
- British Flat Roofing Council
- Building Employers' Confederation
- Department of the Environment (Building Research Establishment)
- Department of the Environment (Property Services Agency)
- English Industrial Estates
- Flat Roofing Contractors' Advisory Board
- Local Authority Organizations
- National Federation of Roofing Contractors
- National House-building Council
- Royal Institute of British Architects

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Foreword

This British Standard has been prepared under the direction of Technical Committee B/546 Flexible sheets for water and water vapour control. It supersedes CP 144-3:1970 which is withdrawn.

BS 6229:1982 gives recommendations on the design of flat roofs combining various types of continuously supported roof covering, insulation materials and roof decks.

A flat roof typically comprises ceiling, structural supports, roof deck, waterproof covering and surface protection and incorporates insulation and drainage. It may support ancillary items such as engineering equipment, hand railing and lightning conductors.

This British Standard gives detailed recommendations for built-up felt roofing on roofs designed to conform to BS 6229. Much of the information is equally relevant to built-up roofing on sloping roofs also covered by this code.

The only high performance felts currently covered by BS 747 are polyester reinforced felts class 5B, 5U and 5E. Other types of high performance felt are available, in particular torch-on felts, modified bitumen felts and elastomeric felts. These have advantages for particular circumstances. Specific reference should be made to manufacturer's advice and agrément certification for the use of these felts.

For convenience, recommendations for methods of attachment and recommendations for built-up felt roofing of different grades are given in Annex A and Annex B.

It has been assumed in drafting this British Standard that construction will be carried out by trained operatives under the direction of qualified supervisors.

It is recognized that this standard may not fully cover all types of felt materials or application techniques.

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.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 28, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This British Standard gives recommendations for the selection of bitumen roofing felts, their combination to form built-up roof felting and their application to flat and sloping roofs.

It does not deal with single layer bitumen felt roofing or with torch-applied membranes.

2 References

2.1 Normative references

This British Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate points in the text and the cited publications are listed on page 28. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this British Standard only when incorporated in the reference by updating or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

2.2 Informative references

This British Standard refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to latest editions.

3 Definitions

For the purposes of this British Standard the definitions given in BS 6100-1.3.2:1989 apply together with the following.

3.1

built-up felt roofing

two or more layers of bitumen roofing felt bonded together with bonding compound to form a continuous waterproof covering

3.2

first layer

layer of roofing felt which is laid first

3.3

intermediate layer

any layer of roofing felt which is applied between the first layer and the top layer or cap sheet

3.4

top layer

uppermost layer of roofing felt which requires the application of surface protection

3.5

cap sheet

bitumen roofing felt which incorporates a protective finish

3.6

bonding compound

oxidized bitumen or other suitable bitumen compound melted and used hot

3.7

dressing compound

bitumen solution designed to receive an application of chipping surfacing

3.8

full bonding

use of a coat of bonding compound continuously to adhere a layer of roofing felt

3.9

high performance felt

bitumen roofing felt conforming to class 5 of BS 747:1994, or of equivalent performance

3.10

partial bonding

use of a controlled quantity of bonding compound so as to leave interconnecting areas unattached to the substrate

3.11

substrate

surface upon which built-up felt roofing is laid

3.12

roof deck

part of the roof construction which carries the load

3.13

cold deck roof (cold roof)

roof in which any thermal insulation is beneath the roof deck

NOTE In heated buildings it is essential that any void between deck and insulation is ventilated

3.14

warm deck roof (warm roof)

roof in which the principal thermal insulation is placed above the roof deck

3.15

inverted roof (upside down roof)

warm deck roof in which thermal insulation is placed above the waterproof covering

3.16**access roof**

roof used to provide access to plant or equipment

3.17**terrace roof**

flat roof for use as an amenity area

3.18**vapour control layer**

layer of vapour resistant material applied specifically to control the passage of moisture vapour

4 Exchange of information

For each project there should be a full exchange of information amongst all involved with the roofing. A detailed specification should be prepared, together with general arrangement and detail drawings, for each area of roof. For design considerations, see clause 8. The various parties should agree:

- a) levels and dimensions of the areas to be roofed;
- b) construction including the deck and any preparation required;
- c) falls and drainage arrangements;
- d) any vapour control layer;
- e) any penetrations, fixtures, or attachments;
- f) the composition of the built-up felt roofing, the method of attachment to the substrate and the type of surface protection;
- g) provision for access to the works;
- h) provision for temporary storage of materials and location of plant including limitations of roof loading;
- i) provision of scaffolding, hoists, ladders and safety equipment, temporary lighting, power, water and temporary protection including temporary shoring and walkways;
- j) facilities for removal of rubbish and surplus material;
- k) requirements for supervision, inspection, and testing.

5 Materials**5.1 Roof decks**

Built-up felt roofing should only be applied over a continuous substrate which provides full support for the roofing; the type of substrate will critically influence the choice of built-up felt roofing and its method of attachment (see clause 8).

Materials used to form the roof deck in flat roofs should be those listed in BS 6229:1992.

Recommendations for the selection and preparation of those roof decks to receive built-up felt roofing are given in clause 6. The same materials may also be used to form the substrate in pitched roofs intended to be covered by built-up felt roofing. The materials are:

- a) concrete decks;
- b) wood wool slabs;
- c) profiled metal decking;
- d) timber boarding;
- e) plywood;
- f) wood particle board.

Timber boarding, plywood and wood particle board are liable to deteriorate if they are persistently wet.

Wood wool slabs should be screeded and/or pre-felted to form a suitable substrate for the direct application of bitumen felt as a vapour control layer or built-up felt roofing. The pre-felted layer should not be considered as part of the built-up roofing.

When channel-reinforced wood wool slabs are used to form the deck in a cold deck roof the designer should consider the need to insulate the channels to avoid thermal bridging.

Profiled metal deck does not, by itself, provide a continuous substrate; it should be overlaid with a rigid board or sheet material to provide support for built-up felt roofing.

For the purposes of this British Standard, concrete decks may be taken to include both in-situ and pre-cast concrete and all flush finish cementitious screeds.

5.2 Thermal insulations

Insulation materials suitable for use in flat roofs are listed in BS 6229; they are of three basic types: fibrous materials, rigid boards, and low-density cementitious or bitumen-bound perlite screeds.

NOTE Fibrous materials are commonly used for the insulation of cold deck roofs and are normally installed at ceiling level by the builder.

Rigid insulation boards used on warm deck roofs and inverted roofs are normally supplied and fixed by the roofing contractor.

Low density cementitious and bitumen-bound perlite screeds should only be installed by contractors specializing in such work.

The type of thermal insulation material chosen will influence the choice of built-up felt roofing and its method of attachment.

In warm deck roof construction it is essential that the choice of insulation and its method of attachment be considered in relation to any vapour control layer (see clause 8).

Recommendations for the selection and installation of the various rigid insulation materials commonly used in flat roofs are given in clause 7.

5.3 Roofing felts

BS 747 lists bitumen roofing felts suitable for use to form waterproof coverings on flat and pitched roofs when applied in accordance with this British Standard. Other bitumen roofing felts may also be used but it should be established that they have been properly evaluated and found suitable for use on such roofs.

Annex B gives guidance on the relative durability of built-up felt roofing. For conditions of use where the membrane may be exposed to persistent dampness, such as use in an inverted roof, or where the membrane may be subject to abrasion or may have to accommodate differential movements within the substrate, only BS 747:1994, class 5 or equivalent high performance felts should be incorporated.

5.4 Ancillary products

5.4.1 General

Built-up felt roofing requires the use of various ancillary materials and products, some of which are covered by British Standards. It should be established, by reference to manufacturer's information and test results, whether materials and products not covered by a British Standard will be suitable for use in built-up felt roofing.

5.4.2 Bitumen primer

Bitumen primer should be bitumen cut back with volatile solvent; it should have the following characteristics when tested in accordance with BS 2000-72:

- a) minimum volatile solvent content: 40 % by mass;
- b) maximum viscosity (STV at 25 °C, 4 mm orifice): 10 s.

5.4.3 Bonding compound

Bonding compound should consist of oxidized bitumen conforming to the requirements of BS 3690-2. Bonding compound is available in grades which are designated by numbers representing the softening point temperature and penetration when tested in accordance with BS 2000-49 and BS 2000-58.

Table 1 shows grades used in built-up felt roofing.

Table 1 — Grades used in built-up felt roofing

Common description (grade)	Softening point (ring and ball) °C	Penetration range at 25 °C mm
85/25	80 to 90	20 to 30
95/25	90 to 100	20 to 30
105/35	100 to 110	30 to 40
115/15	110 to 120	10 to 20
NOTE 1 The values listed are those of materials as delivered to site.		
NOTE 2 Heating of bitumen may result in small changes from the listed figures.		

Attention is drawn to the recommendations regarding heating of bitumen given in 9.1.

5.4.4 Dressing compound

Dressing compound should be hot or cold applied bitumen solution conforming to BS 3690-1.

5.4.5 Nails

Nails for fixing felt should be galvanized extra large round-headed clout nails conforming to BS 1202-1.

5.4.6 Aluminium edging

Aluminium edging for use as edge trim should be designed for that purpose and made from materials which conform to grade 6063T4 or 6063T6 of BS 1474. Lengths are generally restricted to 3 m.

5.4.7 Triangular fillets

Triangular fillets should be formed of cork, fibre building board or other suitable insulation board or treated timber.

5.4.8 Stone aggregate

Stone aggregate for use as a surface protection applied in bitumen dressing compound over a built-up membrane, should be pea gravel or crushed rock not less than 10 mm nominal size graded as single sized aggregate for flat roofing.

NOTE Single sized aggregate as defined in BS 882 allows too high a proportion of fines for use on flat roofing.

5.4.9 Ballast

Ballast for use on inverted roofs should be clean, rounded aggregate graded 40 mm to 20 mm and as free as practicable from fines.

5.4.10 Concrete paving slabs

Concrete paving slabs for use as walkways or as paving on terrace decks, including inverted roofs, should conform to BS 7263-1 when supported only at their edges. Slabs which are fully supported can be of dense concrete but need not have such high strength characteristics.

5.4.11 Walkway tiles

Tiles to form walkways or terrace deck paving are available from several manufacturers. They are normally bedded in bonding compound and should be fixed in accordance with manufacturers' recommendations.

6 Roof decks

6.1 General

Recommendations for the installation and preparation of roof decks of the materials listed in 5.1 to receive built-up felt roofing are given in 6.2 to 6.8.

Decks are frequently overlaid with cementitious screeds, and with rigid or semi-rigid board materials. The preparation of cementitious screeds to receive built-up felt roofing is described in 6.3. Recommendations for the installation of rigid insulation board materials are given in clause 7.

6.2 Reinforced concrete

Where a roof slab of reinforced concrete is designed as the deck which will directly support built-up felt roofing, it is preferable to lay the slab to provide adequate drainage falls as recommended in BS 6229. Provision should be made for drying out the slab. A concrete surface which is not adequately smooth, or does not provide even drainage falls, should be screeded. The surface of the concrete should be finished with a wood float to provide a reasonably smooth surface free from ridges and hollows and should be primed with bitumen primer before built-up felt roofing is laid.

For roofs of slope up to and including 10° the first layer of felt should conform to type 3G of BS 747:1994 to achieve partial bond. Above 10° slope the specification should include a dry insulation board bonded on to a fully bonded vapour control layer. The first layer of felt should be fully bonded or partially bonded to the dry insulation board. Nailing battens should be included on sloping roofs (see 8.9).

Pre-cast reinforced concrete units and composite constructions incorporating hollow tiles, pre-cast beams and planks, etc. should be overlaid with a cement-sand topping finished as described in 6.3.

6.3 Cementitious screeds

Where a reinforced concrete roof slab is overlaid with screed to provide falls, such screed should be laid in accordance with BS 6229. The surface should be finished with a wood float to provide an even surface, free from ridges and hollows and should be primed with bitumen primer before built-up felt roofing is laid. The first layer of felt should conform to type 3G of BS 747:1994 to achieve partial bond. Above 10° the specification should include a dry insulation board bonded on to a fully bonded vapour control layer. The first layer of felt should be fully bonded or partially bonded to the dry insulation board. Nailing battens should be included on sloping roofs (see 8.9).

6.4 Wood wool slabs

Roof decks of wood wool slabs should be formed from slabs conforming to type SB of BS 1105:1981, not less than 50 mm thick with a pre-screeded or pre-felted top surface. Pre-screeded wood wool slabs should be primed prior to the application of a first layer of felt conforming to type 3G of BS 747:1994 to provide a partially bonded built-up felt roofing specification. Joints of plain edged slabs should be joint covered with 100 mm wide bitumen felt tape to prevent the penetration of hot bonding bitumen. With channel reinforced slabs it is only necessary to tape end joints.

Pre-felted wood wool slabs may be used to provide temporary weather protection and a vapour control layer in warm roof construction. Joints should be taped with 100 mm wide bitumen tape bonded with cold or hot applied bitumen. A partially bonded first layer of felt conforming to type 3G of BS 747:1994 should be used when built-up roofing is being installed directly to the pre-felted slabs.

Where channel reinforced wood wool slabs are specified, the channels may form a thermal bridge unless protected on the outside by insulation. To reduce the risks of condensation a warm roof system should be constructed by applying a suitable insulation over the wood wool slabs with a vapour control layer. Where a vapour control layer giving a resistance of over 300 MN s/g is required, pre-felted slabs should be laid with taped joints and an additional layer of fully bonded bitumen felt.

Where there is a risk of movement in the slabs which could damage the roofing membrane or vapour control layer, a taping strip of high performance felt conforming to type 5U of BS 747:1994 or similar should be used.

6.5 Profiled metal decking

Metal decking does not provide a continuous supporting surface for the application of built-up felt roofing, therefore the decking should be overlaid with a rigid board or sheet material secured to the crowns of the decking profile. Thermal insulation boards (as described in clause 7) are commonly used in this way.

In circumstances where limited vapour control is required, a vapour control layer may be formed of felt conforming to type 5U of BS 747:1994 or other similar materials bonded or mechanically fastened to the crowns of the deck. Where higher degrees of vapour resistance are necessary, a two layer or a fully supported vapour control layer should be installed.

NOTE Pending the preparation of a British Standard, attention is drawn to the recommendations for the design of profiled metal decking given in the MRDA *Code of Design and Technical Requirements for light gauge metal roof decks*[1].

6.6 Timber boarding

Roof decks of timber boarding should be designed in accordance with BS 6229 and BS 5268-2. The timber should be naturally durable or pre-treated against infestation by wood-boring insects and fungal decay as recommended in BS 5268-5. Any method of pre-treatment specified should be compatible with the use of bitumen based products.

Boarding should be not less than 19 mm nominal thickness, planed, closely clamped together with tongued and grooved joints or closely butted and secured by nailing with heads not protruding.

Timber boarding does not require priming; the first layer of felt should conform to type 5U of BS 747:1994 or equivalent attached by nailing as described in 9.12.3.

6.7 Plywood

Roof decks of plywood should be designed in accordance with BS 6229 and BS 5268-2. The plywood should conform to the relevant requirements of BS 6566-1 to BS 6566-8, should be specified as veneer plywood and should:

- a) be WBP bonded in accordance with BS 6566-8:1985;
- b) have a plywood durability of Class M of BS 6566-7:1985 or higher, or alternatively be preservative treated at least to the minimum requirements of BS 6566-7. Any treatment should be compatible with bitumen over prolonged periods.

NOTE It is not normally necessary to specify a plywood of appearance quality higher than Grade III of BS 6566-6:1985.

Plywood for roof decks may be square edged or tongued and grooved. Longitudinal joints should occur on the centre line of supporting joists. Cross joints should be staggered and in the case of square edged boarding, require additional support, e.g. by noggins. For thinner sheets, stiffness can depend on ply grain direction. Such sheets should where possible be laid to obtain maximum stiffness at right angles to the joists. Panels supported on a timber structure should be fixed using ring shank nails at 300 mm centres.

Panels should be checked with a moisture meter before installation and if possible laid at a moisture content of 14 % to 18 %. A joint gap of 1 mm per metre of the panel size should be allowed. Plywood should not be laid with a moisture content greater than 18 %.

6.8 Wood particle board

Decks of wood particle board should be designed in accordance with BS 6229. The particle board should be of the appropriate type given in BS 5669-5. Boards should be protected from the weather and should remain dry.

All edges of boards should be fully supported and the boards should be secured with corrosion resistant ring shank nails. Panels should be fixed with a gap of approximately 3 mm at all edges and a gap of 10 mm should be left at the roof perimeter.

The use of pre-felted boards can give immediate temporary weather protection provided the joints are taped at the time of fixing. The pre-felted layer should consist of a felt conforming to BS 747:1994 and bonded to the board as a factory operation with 95/25 bonding bitumen (see Table 1).

Alternatively, a specially manufactured roofing felt meeting the above requirements but with sufficient additional coating on the underside to provide an adhesive face when suitably heated, may be used.

The pre-felted face should be laid uppermost but should not be regarded as part of the bitumen felt specification. The subsequent initial layer should be partially bonded by spot, strip or frame bonding or by the use of a venting base layer.

The material used for taping should conform to BS 747:1994 or equivalent. The taping of the board joints should proceed simultaneously with the fixing of the boards so that in the event of rainfall the minimum area of untaped joints is left exposed. All joints should be sealed by the end of each day's work with a temporary edge protection for uncompleted work.

The tapes should be adhered and sealed either by a mopping of hot bonding compound or cold applied adhesive.

7 Rigid insulation boards

7.1 General

Recommendations for materials and installation for various types of rigid insulation board for use in warm roofs to be covered with built-up felt roofing are given in 7.2 to 7.9.

The various types are:

- a) compressed cork;
- b) fibre building boards;
- c) extruded expanded polystyrene;
- d) rigid polyurethane/polyisocyanurate foam;
- e) rigid glass/mineral fibre insulation boards;
- f) cellular foamed glass slabs;
- g) perlite boards;
- h) pre-felted expanded polystyrene (bead boards).

The type, thickness and shape (plain or tapered board) of insulating materials should be clearly specified together with the pattern of laying and the method of fixing/attachment to the deck. Insulating materials should be used in accordance with the manufacturer's instructions.

7.2 Compressed cork

The boards should consist of pure granulated cork, compressed into slab form and held together by natural cork gum; the minimum density should be 110 kg/m^3 . Cork is suitable for the direct application of hot bitumen: boards may be fully bonded in hot bonding compound and/or be mechanically fastened. The first layer of built-up felt roofing should be fully bonded to the top surface of cork insulation boards.

7.3 Fibre building boards

7.3.1 Softboard

Softboard should conform to type SBN of BS 1142:1989. Fibre insulation boards are suitable for direct application of hot bitumen; they should be fully bonded in hot bonding compound and/or be mechanically fastened. The first layer of built-up felt roofing should be fully bonded to the top surface of fibre insulation boards.

7.3.2 Impregnated softboard

Impregnated softboard should conform to type SBS or type SBI of BS 1142:1989. The density should not exceed 400 kg/m^3 . This material is suitable for direct application of hot bitumen; the boards should be fully bonded in hot bonding compound and/or be mechanically fastened. The first layer of built-up felt roofing should be fully bonded to the top surface of bitumen-impregnated fibre insulation boards.

7.4 Expanded extruded polystyrene

Expanded extruded polystyrene should be of the low ozone depletion type and conform to grade SHD, type A of BS 3837-2:1990. Expanded extruded polystyrene is unsuitable for use in a warm roof construction where insulation is located beneath the built-up felt membrane. The boards should be laid loose and ballasted in accordance with the manufacturer's instructions.

7.5 Rigid polyurethane/polyisocyanurate foam

Insulation boards of rigid polyurethane or polyisocyanurate foam should conform to BS 4841-3. Boards should be fully bonded in hot bonding compound and/or be mechanically fastened. The first layer of built-up felt roofing should be partially bonded with felt conforming to type 3G of BS 747:1994 to the top surface of the boards.

7.6 Rigid glass/mineral fibre insulation boards

Insulation boards of rigid glass or mineral fibre should be of minimum nominal density 170 kg/m^3 . They generally have a low laminar strength and some boards are manufactured with a treatment or facings to provide an improved surface for the application of hot bonding compound. This can produce a high laminar strength board. Depending upon design wind pressure it may be necessary to take special precautions in exposed areas against delamination of low laminar strength boards. The boards may be fully bonded in hot bonding compound and/or mechanically fastened. The first layer of built-up felt roofing should be fully bonded with felt conforming to type 5U of BS 747:1994 or equivalent.

7.7 Cellular foamed glass slabs

Cellular foamed glass insulation slabs should have a density between 120 kg/m^3 and 130 kg/m^3 although, where regular foot traffic is anticipated, higher density slabs (approximately 200 kg/m^3) should be specified. The slabs should be fully bonded in hot bonding compound. The first layer of built-up felt roofing should be fully bonded with felt conforming to type 5U of BS 747:1994 or equivalent. Cellular foamed glass insulation slabs are susceptible to mechanical damage during installation.

7.8 Perlite boards

Perlite insulation boards should have a density between 170 kg/m^3 and 180 kg/m^3 . Perlite boards have low laminar strength and may be vulnerable to delamination; special precautions may be necessary depending upon the design wind pressure. Perlite is suitable for the direct application of hot bitumen and boards should be fully bonded in hot bonding compound and/or be mechanically fastened. The first layer of built-up felt roofing should be fully bonded with felt conforming to type U of BS 747:1994 or equivalent. Consideration should be given to the need for additional mechanical fixing.

7.9 Pre-felted expanded moulded polystyrene (bead boards)

Expanded polystyrene boards should be pre-felted. They should always be overlaid by a layer of fibre insulation board not less than 12 mm thick, cork board or other suitable insulation bonded to the pre-felted layer to provide protection against the heat of the bonding compound. The first layer of built-up felt roofing should then be fully bonded to the fibre board.

Moulded expanded polystyrene should conform to HD or EHD grade, type A of BS 3837-1. This material is extremely heat sensitive. Expanded polystyrene boards should be mechanically fastened or bonded in hot bonding compound which is allowed to cool to a tacky consistency after spreading and before application of the boards.

8 Design considerations

8.1 Design of the roof

For each roof the designer should first determine the form (pitched or flat) and the type (cold deck, warm deck, or inverted) before selecting the appropriate deck material, insulation, and means of vapour control.

The design of flat roofs intended to be covered by built-up felt roofing should conform to the recommendations of BS 6229:1982 with regard to:

- a) dead and imposed loads;
- b) design wind pressure;
- c) structural strength, stiffness and deflection limits;
- d) attachment of the roof deck to the structural framing;
- e) the provision of insulation;
- f) the assessment of condensation risk and the provision of vapour control layers;
- g) sound insulation;
- h) fire precautions;
- i) roof attachments, fixtures and penetrations;

j) falls and drainage;

k) means of access for inspection and maintenance.

8.2 Design of built-up felt roofing

When designing built-up felt roofing it is particularly important to consider the substrate, the control of water vapour, the method of attaching the roofing to the substrate, the strength of the built-up roofing, the provision of protection, and the provision of access for inspection.

The desired properties of the roof covering should be determined and specified accordingly. Design decisions, including those concerned with quality, should be clearly and unambiguously described, specified and detailed.

8.3 Substrates

The substrate onto which built-up felt roofing is to be laid should be sufficiently rigid, dense and dimensionally stable to support the membrane. Its nature will be largely determined by the type of roof selected (warm deck, cold deck, or inverted) and the substrate will in turn have a direct influence on the method of attaching the built-up felt roofing.

Reference should be made to clause 6 for detailed recommendations regarding substrates and their preparation to receive built-up felt roofing.

In order to support the loads imposed by traffic, insulation boards for use in warm deck roofs should be capable of resisting permanent deformation or damage when subjected to concentrated loads. They should also have an even dust-free surface and sufficient laminar strength to resist, with a margin of safety, any stress imposed by wind uplift forces.

8.4 The control of water vapour

Any provision required to control interstitial condensation within the roof should be determined as recommended in BS 6229 but with calculation method modified to conform to BS 5250.

NOTE BS 5250 is a later publication than BS 6229 and gives an improved calculation method. BS 6229 is currently being revised.

8.5 Vapour control layer

For the purpose of calculation it should be assumed that one layer of roofing felt, laid and fully bonded, would provide a water vapour resistance of the order of 300 MN s/g ($\mu_l = 58$). Two layers laid and bonded would provide a water vapour resistance of the order of 500 MN s/g ($\mu_l = 95$) and three built-up layers of felt conforming to type 3B, 5B or 5U of BS 747:1994, when fully bonded to a continuous supporting substrate with all joints lapped at least 50 mm and bonded, would provide a water vapour resistance of the order of 900 MN s/g ($\mu_l = 173$).