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Reinforced bitumen membranes (RBMs) for roofing – Guide to selection and specification

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Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 32, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI and came into effect on 29 June 2007. It was prepared by Subcommittee B/546/1, *Reinforced bitumen membranes*. A list of organizations represented on this committee can be obtained on request to its secretary.

Relationship with other publications

Some products included within this Standard used to be commonly referred to as roofing "felts", and were covered by BS 747:2000. The new European product standard BS EN 13707, which will replace BS 747, refers to these as "flexible bitumen sheets for roof waterproofing". This could be confusing to the UK construction industry. Therefore, the title of this guide reflects the current terminology used in the UK and in the Code of Practice, BS 8217.

These products are now referred to as "Reinforced Bitumen Membranes (RBMs) for Roofing".

In flat roofing applications, these materials are almost always used with a fully supporting substrate. The exception is on a profiled metal deck, where the top flats (crowns) of the profile are used for support.

General flat roofing design is covered in BS 6229.

Specific roof design and installation of these membranes is covered in BS 8217.

BS 8747 gives guidance on the selection and use of RBMs, including those specified in BS EN 13707. Guidance in specifying RBMs equivalent to those specified in BS 747:2000 (but not covered by BS EN 13707) is included in Annexes B and C.

Publications are also available that give useful advice on construction safety (see Bibliography).

Information about this document

This guide provides "primary advice" to the specifier with respect to the production of an effective roof, and is intended as a link document between the material product standard and the final contract specification.

This British Standard takes the form of guidance and recommendations. It cannot be quoted as a specification, and claims of compliance to it cannot be made.

NOTE It has been assumed in the drafting of this guide 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.

Contractual and legal considerations

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 cannot confer immunity from legal obligations.

Introduction – CEN test methods referenced in this standard

The overall aim of the Construction Products Directive (CPD) [1] is to reduce barriers to trade throughout the European Economic Area.

The CPD has, as an ideal, the concept of performance related test methods. The relationship between the results of test methods and the performance on a roof for reinforced bitumen membranes (RBMs) has not been proven, thus it should not be assumed that the results of such tests indicate accurately the in-service performance of the membrane(s) tested.

The test methods in BS EN 13707 have been developed in response to product characteristics identified from the Building Regulations [2] or their counterparts in the various Member States. Some of these are required only for installation of the product.

The CEN test methods and product standards have been developed by a committee of experts from Member States. These test methods were based on current standards such as ISOs where possible but in most cases the scope of existing standards did not coincide entirely with the scope of the CEN standards.

Roof waterproofing is an example of this. Most of the test methods are therefore new and there is no history of past values to rely upon for a given product. CEN product standards also stipulate whether the manufacturer declares a value for a given test method, together with a declared tolerance, or states a manufacturer's limiting value.

BS 747:2000 was a recipe standard. As such it was known in the roofing industry that rag-based bitumen felts did not perform as well as polyester-based products. Because of this, it was easy for a specifier to use a BS 747:2000 Type 3 for say garages or sheds, and BS 747:2000 Type 5 for roofs over offices and computer installations.

This will not be possible with BS EN 13707, because it gives no indication as to what values, as a result of carrying out tests, are required or appropriate for given end uses.

This committee has selected, through expert knowledge and a limited amount of testing, those test methods which it is believed are most suitable and relevant to performance on a roof, and has assigned threshold values which can be used to conveniently group the products into bands of performance. The worked examples are also based upon industry knowledge and experience.

Table 5 correlates end use and substrate with membrane type and choice.

1 Scope

This British Standard gives guidance to assist the selection and specification of a system of appropriate layer(s) of reinforced bitumen membrane (RBM) for each flat and/or sloping roofing project, tailored to the particular requirements of that project.

It provides a grouping system to assist the specifier, utilizing material properties as tested according to BS EN 13707.

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 476-3:2004, *Fire tests on building materials and structures – Part 3: Classification and method of test for external fire exposure to roofs*

BS 6100-1.3.2:1989, *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 6229:2003, *Flat roofs with continuously supported coverings – Code of practice*

BS 8217:2005, *Reinforced bitumen membranes for roofing – Code of practice*

BS EN 12311-1:2000, *Flexible sheets for waterproofing – Determination of tensile properties – Part 1: Bitumen sheets for roof waterproofing*

BS EN 12691: 2006, *Flexible sheets for waterproofing – Bitumen, plastic and rubber sheets for roof waterproofing – Determination of resistance to impact*

BS EN 12730:2001, *Flexible sheets for waterproofing – Bitumen, plastic and rubber sheets for roof waterproofing – Determination of resistance to static loading*

BS EN 13707:2005, *Flexible sheets for waterproofing – Reinforced bitumen sheets for roof waterproofing – Definitions and characteristics*

3 Terms and definitions

For the purposes of this British Standard, the definitions given in BS 6100-1.3.2:1989 and those following shall apply.

These definitions align with those used in other pertinent UK standards; they might differ slightly from those included within European Standards.

This standard introduces and confirms a new primary abbreviation/acronym as mentioned in the foreword: RBMs will henceforth be defined as “reinforced bitumen membranes”.

3.1 built-up reinforced bitumen membrane
built-up RBM
generally, two or more layers of reinforced bitumen membrane, fastened to the substrate, bonded together with sealed joints to form a continuous waterproof covering

3.2 single-layer reinforced bitumen membrane
single-layer RBM
specifically designed bituminous single-layer systems with sealed joints, forming a continuous waterproof covering, and installed according to the manufacturer’s specific instructions

3.3 access roof
roof used to provide access to plant or equipment

3.4 base layer
preparatory layer
layer of reinforced bitumen membrane which is laid first

3.5 bonding bitumen
oxidized bitumen, or other suitable bitumen compound melted and used hot as a bonding agent

3.6 capsheet
uppermost layer of reinforced bitumen membrane which is self-finished, i.e. incorporates a protective finish (e.g. mineral or foil-faced)

3.7 carrier
material incorporated into or onto the factory-made bitumen membrane to ensure its stability and/or mechanical resistance

3.8 cold deck roof
cold roof
roof where 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

NOTE Generally, the cold deck flat roof is no longer recommended, due to the difficulty in providing an effective vapour control layer at ceiling level, the limitations of providing adequate ventilation above the insulation to prevent condensation, and the associated thermal losses.

3.9 detailing capsheet
capsheet used on detail works and upstands, offering more flexibility for forming these

3.10 full bonding
use of a continuous coat of bonding bitumen (or other approved adhesive), or torch application, to fully adhere a layer of reinforced bitumen membrane

3.11 gritting solution
bitumen compound, formulated to bond a layer of site-applied chippings to the surface of the top layer

3.12 intermediate layer
any layer of reinforced bitumen membrane which is applied between the base layer, and the top layer (or capsheet)

3.13 inverted roof
upside-down roof
protected membrane roof
roof where 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

NOTE Generally the principal insulation is secured by ballast, however proprietary lightweight systems are available which do not rely on separate ballast.

3.14 manufacturer's declared value
MDV
value declared by the manufacturer accompanied by a declared tolerance

3.15 manufacturer's limiting value
MLV
value stated by the manufacturer to be met during testing, which can be a minimum or a maximum value according to statements made under product characteristics within a standard

3.16 partial bonding
use of a controlled and regular quantity of bonding bitumen (or other approved adhesive) or torch application, so as to provide adhesion over a proportion of the total area of the substrate

3.17 roof deck
part of the roof construction, which supports the waterproofing system, including as appropriate the vapour control layer and insulation board(s)

3.18 substrate
surface upon which a built-up reinforced bitumen membrane (RBM) is laid

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

3.20 terrace roof
flat roof for use as an amenity area, usually having a specialist, separate, protective surface finish

3.21 top layer
uppermost layer of reinforced bitumen membrane, which will require the application of separate surface protection

3.22 vapour control layer
VCL
construction material (usually a reinforced bitumen membrane) that substantially reduces the transfer of water vapour through the roof build-up

NOTE The performance of a vapour control layer is dependent upon the material, workmanship and buildability. The material chosen for a specific building should be suitable for its internal conditions.

3.23 warm deck roof
warm roof
roof where 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

4 Membrane selection guidelines

4.1 General

The primary reference for flat roof design is BS 6229, and the code of practice for RBM roofing is BS 8217, which should be consulted in conjunction with this Guide, for the selection of RBMs as the waterproofing system.

This guide assumes that the roof deck/substrate has already been selected and thermal requirements considered.

The choice of suitable membrane(s) will be dependent upon a number of factors, including:

- roof deck/substrate;
- slope/pitch;
- building and roof use;
- location and exposure;
- intended access to the building and/or roof areas (by following trades, or for maintenance, etc.);
- possible unauthorized access to the building and/or roof areas (by vandals, etc.);
- insulation type under consideration;
- the extent and complexity of detailing;
- fire performance requirements;
- surface finish; and
- durability/service-life requirements.

Any specification for overlaying of existing materials should be based upon a close condition survey, and if necessary, core sampling and non-destructive testing, to establish the exact makeup and condition of the lower layers and substrate.

In refurbishment projects, consideration should be given to correcting any inadequacy of falls, by the use of tapered insulation boards or re-decking with improved falls.

It is more than likely that such projects will need to comply with regulatory requirements for thermal insulation.

If not undergoing planned maintenance, there is also a need to establish the mode of failure of the roof, and to correct any detailing or design inadequacies.

4.2 Principles

In reinforced bitumen membrane roofing, it is usual to recommend systems comprising two working waterproofing layers (plus any preparatory layer, such as a Type 3G).

The underlayer provides the generic flexibility and has the capacity to absorb movements.

The second layer, either a capsheet or a top layer, provides resistance to and protection against impact damage or static loadings, and in the case of roof gardens, root protection.

Improved durability will be achieved by using a system incorporating layers having a polyester carrier, which provides a higher tensile strength S, and/or better puncture resistance P, as categorized in Table 5.

*SBS polymer-modified bitumen membranes (**4.4.2**), with greater extensibility and flexibility, especially at low temperatures, are likely to provide improved fatigue resistance, and hence a longer service life.*

To further extend the potential service life, the SP specification of the two working waterproofing layers could be increased, or an additional third working layer included.

Generally, the UK industry tends toward the former option.

The method of installation/attachment of the waterproofing system can have a bearing upon the choice of insulation, and vice versa. For further guidance, see the appendices of BS 8217.

4.3 Caveats

Prior to considering the roof design, the building structure and its proposed use should be confirmed and clearly stated in the project documents, as described in BS 6229.

The following factors need to be considered during the selection of the waterproofing system build-up, as described in BS 8217:

- wind loading;
- roof slope;
- overall attachment method (pour-and-roll/torch applied, full/partial bond, cold/self-adhered/mechanically fixed);
- type and thickness of thermal insulation;
- internal conditions and hence condensation risk;
- fire requirements/escape/rating;
- degree of detailing involved, e.g. for penetrations, or drainage;
- intended access to the building and/or roof areas (by following trades, for maintenance, etc.);
- intended use or access of the roof for recreational purposes; and
- roof finishes for garden or environmental purposes (e.g. root resistance).

In any refurbishment project, the thickness of insulation chosen should not be allowed to compromise the upstand height or the function of the cavity tray or damp proof course.

Refurbishment projects have been included in the flow charts (Table 7 and Table 8), by noting two additional substrates: existing asphalt, and existing RBMs.

NOTE The existing substrate and structure are assumed to have been inspected and assessed by a competent person as suitable and safe for re-roofing and/or re-waterproofing.

The location, purpose and expected service life of the roof all have an impact on the specification, and the relative importance of the above factors. See also the worked examples in Annex D.

Examples of variable factors (see Table 5).

a) Location: when considering a tower block in an exposed area, e.g. Scotland, wind uplift resistance and therefore tensile strength *S* and attachment method should be of major concern.

b) Purpose: with a heavily trafficked low-level roof area in a sheltered area, the puncture resistance *P* (both static and dynamic) will be more important.

c) If the roof is likely to be subject to vandalism and damage, then the puncture resistance *P* (both static and dynamic) would again be important.

d) Expected service life: if access to the roof is difficult, then the area may only rarely be inspected or maintained, thus requiring the use of a higher classified material (following the SP system [**4.8**]).

Good values for durability, elongation and pliability will also be important.

Specifiers who select their materials according to a classification listed in this standard are generally advised to require the materials to be sourced from a single manufacturer.

This is particularly important if a combined manufacturer/installer warranty is required.

It is then also advisable to select an installer who is experienced with the chosen system, and/or approved by the manufacturer.

4.4 Types of RBM for roofing

4.4.1 RBM with oxidized bitumen

Oxidized bitumen membranes are suitable for use to form waterproof coverings.

Those for RBM roofing comprise polyester or glass fibre or glass/polyester mixed base carriers, saturated and coated with oxidized bitumen.

These products are designed only for pour-and-roll application, cold adhesive application, or nail-fixing (as a preparation layer).

4.4.2 RBM with SBS-modified bitumen (elastomeric)

Elastomeric modified bitumen membranes are produced on polyester, glass fibre, and glass/polyester mixed base carriers. The carrier is saturated and/or coated with bitumen, modified with thermoplastic rubbers, commonly referred to in the UK as styrene butadiene styrene (SBS).

These products can be manufactured as suitable for application by pour-and-roll, by torching, by use of cold adhesive, as a self-adhesive material, or by mechanical fastening.

4.4.3 RBM with APP-modified bitumen (plastomeric)

Plastomeric modified bitumen membranes are produced on polyester, glass fibre, and glass/polyester mixed base carriers. The carrier is saturated and/or coated with bitumen, modified with polyolefin or a polyolefin copolymer, commonly referred to in the UK as atactic polypropylene (APP).

These products are primarily manufactured as suitable for torch application.

They may be used with cold adhesives, but only in strict accordance with the membrane manufacturer's instructions.

They are *not* suitable for pour-and-roll, or generally for mechanically fastened applications.

4.5 Pre-filtering

With regard to the RBM, some of the parameters encompassed by BS EN 13707 have simple pass/fail results. In order to be considered viable for specification, an RBM should pass:

- watertightness, for all applications; and
- root resistance, for green or garden roofs.

In addition, manufacturers might provide declared values or limiting values for the following parameters, which are unlikely to have a bearing on the selection of a system. For this Guide, no values have been set.

- Adhesion of granules (for mineral-finished capsheets).
- Shear resistance of joints (for single-layer systems only).
- Peel resistance of joints (for mechanically fastened single-layer systems only).

The manufacturer might also have declared a group classification (e.g. S2P1) under the classification recommended in Table 5 of this Guide.

4.6 Relevant product data

4.6.1 General

The following parameters are relevant to the selection process, and can appear in the CE mark itself, or in the product data sheet for the material.

Many parameters are primarily dependent upon the choice of carrier, while others are based on bitumen performance.

4.6.2 Tensile strength (*S*)

Tensile strength indicates the maximum force applied during testing (see Table 1).

Typical tensile strength values for membranes currently available lie between 150 N/50 mm and 900 N/50 mm, and are dependent upon the carrier. Increased tensile strength provides greater security when a lightweight or flexible deck or substrate is chosen.

In combination with elongation and pliability, this parameter affects fatigue and durability.

Tensile strength is important in the choice of a VCL for use on a profiled metal deck, because the layer is not fully supported. An S3 would be the minimum class.

4.6.3 Elongation

The extension, measured at the maximum force applied during tensile testing (see **4.6.2**).

It is dependent upon both carrier and type of bitumen used.

Typical elongation values for membranes currently available lie between 3% and 45%.

Sufficient elongation (circa 15%) is required to resist the major movements occurring during the construction phase, particularly on a lightweight long-span profiled metal deck.

4.6.4 Nail shank tearing test

Resistance to tearing around a nail. Primarily dependent upon the carrier.

Nail fixing is used for the first layer on a close-boarded timber deck, and for all layers on sloping or vertical roof surfaces.

A minimum figure of 175 N is recommended, for nailed-down bitumen membranes.

4.6.5 Static load resistance (*L*)

Resistance to a standard point loading (see Table 3). Primarily dependent upon the carrier.

Important for supporting construction or maintenance traffic, and for constant loads, e.g. plinths, plant, etc.

Partly dependent upon the compressive strength of the substrate.

4.6.6 Impact resistance (D)

Impact resistance is the resistance of a reinforced bitumen membrane to impact damage.

This is tested using a round-headed impactor of stated diameter and mass (see Table 2), which is dropped from increasing heights, to produce greater impact energy.

Hence, the greater the drop height, without penetration, the better the resistance.

Impact resistance is primarily dependent upon the carrier, and is mainly needed to reduce the risk of mechanical damage during the construction phase or planned maintenance (hence the term, “falling hammer test”).

Higher impact resistance is important if used on a softer substrate.

4.6.7 Flexibility at low temperature (pliability)

Pliability is the lowest temperature at which the product will bend round a 30 mm mandrel without cracking. Pliability is primarily dependent upon the type of bitumen and product thickness.

This probably ranges from +10 °C to −30 °C, and is typically used to characterize the product. It is related to installing the products around details.

The lower the pliability figure, the more usable/malleable the product.

4.6.8 Flow resistance at elevated temperatures

Measure of flow at elevated temperature; only related to bitumen type.

Typical values are between 90 °C and 160 °C

Higher values are recommended for exposed upstands, and for sloping and vertical work.

NOTE In practice, the installation method will have more effect on flow resistance.

4.6.9 Durability

The durability test in BS EN 13707 is only a general indication of potential durability in service; a heat ageing test is undertaken to assess the changes introduced in two parameters (pliability, and flow at elevated temperatures).

In summary, the aged low-temperature flexibility is the most significant factor in assessing performance in the long term.

4.6.10 External fire performance

This is required to meet the UK Building Regulations, and will need to be assessed for the particular building under consideration.

The current toughest regulatory requirement is for an AC rating, when tested according to BS 476-3:2004[1)].

In general, this is achieved by self-finished mineral or metal foil-faced membranes.

Many specifiers require fire performance in excess of this basic fire rating, i.e. AB or even AA rating. Many UK manufacturers offer RBM systems with these higher ratings for external fire performance. In addition, some manufacturers offer systems assessed by the Loss Prevention Certification Board (LPCB), recognized by most building insurance companies.

4.6.11 Reaction to fire

Currently, reaction to fire is not a regulatory requirement or relevant to roofing design in the UK.

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1) The test in BS 476-3:2004 will be included as Test 4 of BS EN 1187 (in preparation).

4.7 Reinforced bitumen membrane (RBM) classification

The classification tables (Table 1, Table 2, Table 3 and Table 4) detail performance levels for an individual RBM.

Generally, an RBM with a given classification will meet all of the performance requirements for the lower classifications.

4.8 The SP classification system for RBMs in roofing

4.8.1 Introduction

The system is based on two parameters, tensile strength and indentation and is used to define the following:

a) the performance achieved by any particular membrane; and

b) the performance required by any particular roof construction.

It is applied to the waterproofing layer(s) of an RBM roof system.

4.8.2 General

SP is a performance based classification designed to answer the question: "What performance capacities are required for a product to fit its intended purpose when different levels of operating stress are assumed?"

Two parameters measurable under BS EN 13707 are critical on any roof:

a) tensile strength *S*; and

b) resistance to puncture or indentation *P*.

Each letter is assigned a numerical suffix. The suffix number increases either with the performance capacity of the membrane, or with the greater the stress requirement of the roof.

Membranes are tested against these parameters and are then classified with the code SNPN.

Based on in-use experience, the requirement for performance of at least one of the membranes needs to be classified in the same manner, i.e. SNPN.

Hence, a suitable membrane can be selected to meet the required performance.

4.8.3 Classification of the membrane

4.8.3.1 Principle

Membranes are tested and their classification is determined on the basis of the results obtained.

4.8.3.2 Tensile strength (S)

Materials are tested in accordance with BS EN 12311-1:2000, and Table 1 shows the conditions under which suffixes 1 to 5 are determined.

Table 1 **Tensile strength of membrane classes**

S class	**Tensile strength** N/50 mm	**Approximate equivalent** (per BS 747:2000)
S1	$150 \leqslant S < 350$	Type 3B
S2	$350 \leqslant S < 450$	Type 5U
S3	$450 \leqslant S < 550$	Type 5B/180
S4	$550 \leqslant S < 750$	Type 5B/250
S5	$S \geqslant 750$	Type 5B/250 or 350

NOTE These are minimum values as quoted by the manufacturer, and required in both longitudinal and transverse directions.

4.8.3.3 Puncture or indentation (P)

Membranes are tested for resistance to impact in accordance with BS EN 12691:2006, to give a sub-classification DX (suffix values from 1 to 3), and for resistance to static loading in accordance with BS EN 12730:2001, to give a sub-classification LX (suffix values from 1 to 4).

Table 2 and Table 3 show the range of test results for each suffix.

Table 2 **Resistance to impact**

D subclass	**Drop height** mm
D1	< 700
D2	< 1100
D3	< 1500

Table 3 **Resistance to static loading**

L subclass	**Load** kg	**Approximate equivalent** (per BS 747:2000)
L1	5	Type 3B
L2	10	Type 5U
L3	15	Type 5B/180
L4	20	Type 5B/250 or 350

Classification PX, with suffixes 1 to 5, is based on a combination of the subclasses D and L, as explained in Table 4.

Table 4 **Combinations of D subclass and L subclass to give P class**

Subclass D		**Subclass L**		**Combination**		**P class**
D1	→	L1	→	D1L1	→	P1
D2	→	L2	→	D2L2	→	P2
D2	→	L3	→	D2L3	→	P3
D2	→	L4	→	D2L4	→	P4
D3	→	L4	→	D3L4	→	P5

4.8.4 Classification of the membrane performance requirements

Classification of the roof construction requirement is based on experience acquired with a number of membranes and knowledge of their performance.

The S classification for a membrane indicates the tensile strength level requirement with respect to thermal movement of the substrate.

The tensile criteria have been grouped in five classes from 1 to 5.

The P classification for a membrane indicates the requirement with respect to the puncture resistance of the membrane in service related to the intended purpose of the roof.

The puncture criteria have been grouped in five classes of risk from 1 to 5.

In both parameters, the higher the classification the more severe is the requirement.

Table 5 summarizes the classification in respect of the two parameters, based on experience.

To decide on the required SNPN classification, Table 5 should be consulted, taking into account the substrate, roof slope, usage, thermal performance and required protection.

Designers are free to specify a different set of suffixes if they so wish. This is particularly important in those cases where the actual conditions under which the membrane(s) is/are used will be more/less severe than usual.

4.8.5 Use of Table 5

The table applies to both single layer (-ply) and multi-layer reinforced bitumen membrane systems. In a multi-layer application, one layer (which is usually the underlayer) should have at least an S2P2 classification, except in the case of a perforated layer.

The top layer or capsheet should match or exceed the performance requirement in Table 5.

Table 5 **Membrane classification by performance requirement**

Membrane substrate	**Slope/falls**	**Roof use and type of protection**							
		No access apart from light maintenance		**Accessible roof**				**Equipment maintenance/walkway**	
				Pedestrian	**Vehicles**	**Pedestrian**	**Gardens**		
	Degrees (5° ≈ 1:11)	**Self-protected**	**Ballast (coarse gravel)**	**Slabs/pavers**		**Paving slabs on supports**	**Direct drainage layer**	**Self-protected**	**Slabs over screed/coarse gravel**
Thermal insulation	1 to 5	S3P2[A)]	S2P3[B)]	S4P4	S4P4	S5P4	S2P5	S3P4	S2P3[C)]
	> 5	S3P2[A)]	–	–	–	–	–	S3P4[D)]	–
Concrete	0 to 5	S3P2	S2P3	S4P4	S4P4	S5P4	S2P5	S3P4	S2P3
	> 5	S3P2	–	–	–	–	–	S3P4[D)]	–
Concrete plus protected membrane	0 to 5	–	S2P3	S4P4	–	S2P3[E)]	S2P5	–	S2P3
Aerated autoclaved cellular concrete	1 to 5	S3P2	S2P3	–	–	–	–	S3P4	S2P3
	> 5	S3P2	S2P3	–	–	–	–	S3P4[D)]	–
Plywood, OSB3, or timber boarding	1 to 5	S3P2	S2P3	–	–	–	–	S3P4	S2P3
	> 5	S3P2	S2P3	–	–	–	–	S3P4[D)]	–
Existing membrane	1 to 5	S3P2	S2P3	S4P4	S4P4	S5P4	S2P5	S3P4	S2P3
	> 5	S3P2	–	–	–	–	–	S3P4[D)]	–

A) Puncture index P becomes P3 when on mineral wool, which offers less support against puncture.
B) Puncture index P becomes P4 when on mineral wool, which offers less support against puncture.
C) Puncture index P becomes P4 when on mineral wool or expanded polystyrene, which offer less support against puncture.
D) Flow resistance at elevated temperature is $\geqslant$ 80 °C if $R > 2$ m^2·°C/W.
E) Puncture index P becomes P4 for single ply (layer) membranes.

For ease of comparison between existing classifications and this new SP system, the approximate performance characteristics of current BS 747:2000 membrane types are listed in Table 6.

Table 6 **Comparison between BS 747 membranes and the SNPN system**

BS 747 designation	S class	P class	SNPN classification
Type 3B	S1	P1	S1P1
Type 3E	S1	P1	S1P1
Type 5U	S2	P3	S2P3
Type 5B/180	S4	P4	S4P4
Type 5B/250	S5	P5	S5P5

NOTE The Type 3G is not a waterproofing layer, and is hence non-classifiable under this standard.

4.9 Other significant criteria

4.9.1 Introduction

Having chosen the membranes in accordance with the SNPN classification above, it is necessary to check the following criteria to ensure that the chosen membranes conform with other requirements.

4.9.2 Elongation

If repeated expansion and contraction of the roof deck is likely to occur, such as the movement experienced in a long span metal deck during the construction phase, then consideration should be given to membranes having a high elongation.

4.9.3 Nail shank tearing

If one or other of the membranes are to be mechanically fastened with a nail or a screw and washer then consideration should be given to products with a high value when tested to the nail shank tearing test. A figure >175 N would be acceptable in all instances.

4.9.4 Flexibility at low temperature

If it is expected that the materials are to be installed in winter conditions or that some movement is expected in cold weather then it would be advisable to specify materials with a low bend temperature. Some reinforced bitumen membranes with a polymer modified coating offer flexibility down to −30 °C, and should be considered for onerous applications.

4.9.5 Flow resistance at elevated temperatures

Characterizes the stability of the membrane at elevated temperatures.

4.9.6 Durability

Most polymer-modified and polyester-reinforced bitumen membranes are expected to have a service life in excess of 50 years.

According to BS EN 13707, durability is indicated by the ability of the product to maintain its low temperature flexibility *after* heat ageing.

5 System selection

The flow chart in Table 7 applies to a warm deck roof and Table 8 applies to an inverted roof, based upon the directions in BS 8217.

They aim to provide primary advice to the specifier for the:

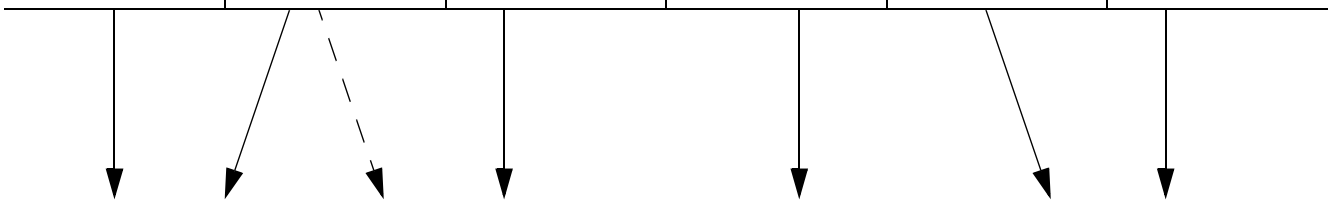
- preparation of substrate;
- selection of bituminous vapour control layers;
- preparation layers (dependent upon insulation choice); and
- reinforced bitumen waterproofing membranes;

in order to produce an effective roof for a given project.

Table 7 **Flow chart for system selection – Warm deck roofs**

Step 1: choose a deck/substrate.

Concrete or screeded surface	Plywood or oriented strand board (OSB) sheets	Close-boarded timber	Profiled metal (e.g. steel, aluminium)	Existing felts (reinforced bitumen membranes)	Existing mastic asphalt
Preparation					
Remove lumps, etc., smooth off surface. Prime and allow to dry.	Lay 150 mm wide taping strip loose over board joints and mop over with bitumen (see Note 3).	Correct any uneven planks and punch in nail heads.	Stitch all side laps. Prime top flats (crowns) of profile and allow to dry.	Clear/scarify chippings. Cut and seal down blisters. Prime surface and allow to dry.	Clear/scarify chippings. Cut and seal down blisters. Prime surface and allow to dry.



Step 2: select a vapour control layer.

NOTE 1 BS 6229 and BS 5250 cover vapour control in detail.

NOTE 2 RH indicates internal level of relative humidity.

NOTE 3 A nailed layer is acceptable on plywood at least 15 mm thick.

RH low: fully bonded RBM (reinforced bitumen membrane)	RH low: nailed RBM to minimum of S2P2 with sealed laps	RH low: S2P2 RBM, fully bonded to top flats (crowns) of deck with sealed laps	RH low: existing system repaired and retained
RH medium: fully bonded RBM	RH medium: nailed RBM layer as above, and fully bond a second S2P2 layer	RH medium: as above and fully bond a second S2P2 RBM layer	RH medium: repair existing finish and fully bond an S2P2 layer
RH high: fully bond metal-cored RBM	RH high: nailed RBM layer and fully bond a metal-cored second layer	RH high: as for low RH and fully bond a metal-cored second RBM layer	RH high: repair existing finish and fully bond a metal-cored RBM layer

Table 7 **Flow chart for system selection – Warm deck roofs** (*continued*)

Step 3: select thermal insulation.

The following are the most commonly used thermal insulation materials for use in warm roof construction. When selecting insulation, reference should be made to BS 6229 and BS 8217.

NOTE 4 Insulation boards should be specifically designed for use in flat roofing.

Polyurethane (PUR)/poly-isocyanurate foams (PIR)	Phenolic foam (PF)	Cork and cork/PUR composites	Expanded polystyrene (EPS)	Rock fibre/glass fibre boards (RW)	Cellular glass (CG)	Expanded Perlite (EPB)

Preparation: after bonding/fixing insulation boards, for pour and roll or torch-on waterproofing systems, the following preparations are needed before the application of the first working waterproof layer.

NOTE 5 These might not be appropriate for other attachment methods.

Apply a Type 3G for pour-and-roll. Proprietary layer for torch-ons.	Apply a Type 3G or similar	None (some manufacturers prefer a preparatory Type 3B layer over cork)	A bonded layer of bitumen-impregnated fibreboard or perlite and taped joints	None	Seal surface cells with a hot bitumen floodcoat	None (although a mechanically fixed overlay might be required to resist wind uplift)

Step 4: select working waterproofing layer(s)

First working layer (underlayer): choose sanded or talc (unprotected) finish and select membrane classification from Table 5 and **4.8.5**.

Final layer: select membrane classification from Table 5 and **4.8.5**.

Top layer, unprotected	Capsheet, self-protected
Choose sanded or talc finish. Will then require one of the following applied surface finishes: bonded chippings; ballast (shingle or paviors); garden roof build-up; or a terrace roof. *NOTE 6 All exposed detail work will require a self-protected capsheet.*	Choose a mineral finish or metal foil facing. (Solar reflective paint can be applied to a mineral finish as suggested in BS 8217.)

NOTE 7 Please refer to the worked examples in Annex D, which demonstrate how this selection and specification guide is intended to be used to establish the appropriate performance classes for RBMs to meet the specific requirements for a given project.

Table 8 **Flow chart for system selection – Inverted warm roofs**

Step 1: choose a deck/substrate.					
Concrete or screeded surface	Plywood or oriented strand board (OSB) sheets	Close-boarded timber	Profiled metal (e.g. steel, aluminium)	Existing felts (reinforced bitumen membranes)	Existing mastic asphalt
Preparation					
Remove lumps, etc., smooth off surface. Prime, and allow to dry.	150 mm wide taping strip laid loose over board joints, and mopped over with bitumen. (See also Note 3 of Table 7.)	Correct any uneven planks and punch in nail heads.	Not normally suitable for the loadings involved in inverted roofs. Seek specialist advice.	Clear/scarify chippings. Cut and seal down blisters. Prime surface and allow to dry.	Clear/scarify chippings. Cut and seal down blisters. Prime surface and allow to dry.
↓					
Step 2: select working waterproofing layer(s)					
First working layer (underlayer): choose sanded or talc (unprotected) finish and select membrane classification from Table 5 and **4.8.5**.					
↓					
Final layer: select membrane classification from Table 5 and **4.8.5**. All exposed detail work will require a self-protected capsheet, e.g. mineral or metal foil faced.					
Top layer, unprotected			Capsheet, self-protected		
Choose sanded or talc finish.			Choose a mineral finish or metal foil facing.		
Insulate with extruded expanded polystyrene (XPS). Will then require one of the following applied forms of ballasting: ballast (shingle or paviors); garden roof build-up; or a terrace roof.			Insulate with filter layers and suitable ballasting per manufacturer's instructions.		

6 Bonding and installation of an RBM

6.1 General

This document details the performance levels for RBMs. Additionally, BS 8217 details the following methods of attachment for RBM:

a) fully bonded in poured hot bitumen;

b) partially bonded in poured hot bitumen;

c) fully bonded by torching;

d) partial bonding by torching;

e) cold bituminous or other specialist adhesives;

f) self-adhesive membranes;

g) mechanical fixing; and

h) loose laid and ballasted roofs.

For certain systems/applications, advice from manufacturers should be sought to ensure that the correct method of attachment is followed for any particular substrate/slope/membrane system combination.

6.2 Sloping roofs and vertical work

A flat roof is defined as having a pitch not greater than 10° to the horizontal in BS 6229.

BS 8217 states that roofs over 5° pitch (sometimes referred to as sloping roofs) require additional retention measures to prevent slippage, and provides methods and guidance for these situations. Similar recommendations apply to vertical work.

6.3 Installation of vapour control layers (VCLs)

An RBM used as a VCL should be a minimum S2P2 classification as stated in **4.8.4**.

This is particularly important with metal decks, where the VCL is not fully supported.

Wherever possible, the level of internal RH should be assessed for the specific project/application. For further information, see BS 8217.

Where a two-layer VCL is required (e.g. above a swimming pool), the first layer should have a high SP value to resist damage, and the second layer should incorporate a metal foil for maximum vapour resistance.

Where a new VCL is not being installed, (i.e. in an overlay situation) a strip of felt of a minimum S2P2 will be required around perimeters, to encapsulate the new insulation (for further information, see BS 8217).

Annex A (informative) CE marking information for an RBM product

A.1 General

It is a legal requirement in the EU that products used in roofing conform to local legislation implementing the Construction Products Directive [1]

As it is a mandated standard under the Construction Products Directive [1], conformity to BS EN 13707 confers a presumption of fitness for intended use of the RBMs it covers, and hence the right of the manufacturer to affix CE marking.

Details of the information to be given on accompanying (technical) documentation when affixing a CE mark is given in Annex ZA of BS EN 13707.

An example of a CE mark is given in **A.2**. below.

A.2 Example of CE marking information

CE 01234	CE conformity marking, consisting of the "CE"-symbol given in directive 93/68/EEC. Identification number of the certification body
AnyCo Ltd, PO Box 21, B-1050 **04** 01234-CPD-00234	Name or identifying mark and registered address of the producer Last two digits of the year in which the marking was affixed Certificate number
EN 13707 1m × 5m × 4mm, polyester non-woven, elastomeric modified bitumen, fine mineral and polymeric sheeting, torchable only. Top layer, not for single layer application, not for roof gardens. External fire performance: B_{ROOF} (t2) see manufacturer's document XYZ* Reaction to fire: F Tensile strength in longitudinal direction: 700 N/50 mm ± 50 N/50 mm Tensile strength in transverse direction: 500 N/50 mm ± 50 N/50 mm Elongation: 30% ± 3% Resistance to static loading: 20 kg Resistance to impact: 20mm Tear resistance: 500 N ± 50 N Pliability: −20 °C Durability: −10 °C ± 5 °C Watertightness: Pass Root resistance: NPD	Number of European product standard Description of product, and information on regulated characteristics

Annex B (informative) Guide to specifying RBM equivalent to Type 1F or Type 5U reinforced bitumen roofing underlay

B.1 Introduction

The following information is provided for those who would like to specify an RBM equivalent to Type 1F or Type 5U in BS 747. To be truly equivalent, all characteristics would have to be specified.

B.2 Characteristics of Type 1F reinforced bitumen roofing underlay

B.2.1 Description

Sheet comprising a bitumen-impregnated and coated fibre base combined with a layer of jute hessian, embedded in the coating on one side of the base so as to reinforce and strengthen the sheet. The sheet is coated with a fine surfacing material to prevent the product sticking in the roll. The presence of the hessian is obvious on inspection. Aluminium foil can be applied to the hessian- reinforced side to provide a heat-reflecting roofing underlay.

B.2.2 Uses

The sheet is suitable for use under tiles or slates, particularly when the sheet is not fully supported by boarding. Their use is more fully covered in BS 5534, *Code of practice for slating and tiling (including shingles)*.

B.2.3 Details of constituent materials

Masses per unit area of constituent materials as shown in Table B.1.

Base: The base, consisting of animal or vegetable fibres made into a close-textured absorbent sheet of fibre.

Impregnating bitumen: Conforming to BS 3690-2 and having a penetration within the range 60 to 230 at 25 °C when tested in accordance with BS 2000-49.

Coating bitumen: The coating material has a softening point (ring and ball test) within the range 80 °C to 120 °C when tested in accordance with BS 2000-58, and consists of oxidized bitumen conforming to BS 3690-2, which can be stabilised with finely divided mineral filler. The proportion of mineral filler does not exceed 40% by mass of the coating material.

Surfacing material: The surfacing material consists of a fine mineral material, e.g. sand.

B.2.3.1 Mass of product

The nominal mass per unit area is 15.0 kg per 10 m^2 exclusive of wrappings or accessories.

B.2.3.2 Standard packages

The product is supplied in rolls 1 m wide, in lengths of 15 m.

B.2.4 Characteristics of Type 5U polyester reinforced bitumen roofing underlay

B.2.4.1 Description

The sheet comprises a bitumen-impregnated and coated polyester base, covered with a fine surfacing material on both sides to prevent the product sticking in the roll. The polyester base provides improved performance capability of the product due to its greater reinforcing properties and mechanical strength.

B.2.4.2 Uses

The sheet is suitable for use under tiles or slates, particularly when the sheet is not fully supported by boarding, offering higher resistance to tearing by comparison with Type 1F sheet. It can be used in combination with Type 1F, as an eaves starter strip where the rot-proof base gives added durability.

B.2.4.3 Details of constituent materials

Masses per unit area of constituent materials as shown in Table B.1.

Base: The base consists of a non-woven sheet of polyester staple fibres or polyester continuous filaments.

Impregnating bitumen: Conforming to BS 3690-2 and having a penetration within the range 20 to 200 at 25 °C when tested in accordance with BS 2000-49.

Coating bitumen: The coating material has a softening point (ring and ball test) within the range 80 °C to 120 °C when tested in accordance with BS 2000-58 and consists of oxidized bitumen conforming to BS 3690-2, which can be stabilized with finely divided mineral filler. The proportion of mineral filler is not greater than 30% by mass of the coating material.

Surfacing material: The surfacing material consists of a fine mineral material, e.g. sand.

B.2.4.4 Mass of product

The nominal mass per unit area is 18.0 kg per 10 m^2 exclusive of wrappings or accessories

B.2.4.5 Standard packages

The product is supplied in rolls 1 m wide, in lengths of 16 m.

Table B.1 **Mass per units area for constituents of Type 1F and Type 5U RBMs**

Type	Nominal mass per unit area	Nominal length of roll	Nominal mass per unit area of base	Masses per unit area obtained by analysis		
				Base min.	Bitumen content min.	Surfacing material (nominal)
	kg/10 m^2	m	g/m^2	g/m^2	g/m^2	g/m^2
1F reinforced bitumen	15	15	160 (fibre) 110 (hessian)	140 90	550	450
5U polyester base	18	16	125 (polyester)	118	700	450

Annex C (informative) Guide to specifying RBM equivalent to Type 3G glass-fibre reinforced bitumen perforated venting layer

C.1 Introduction

The following information is provided for those who would like to specify an RBM equivalent to Type 3G in BS 747. To be truly equivalent, all characteristics would have to be specified.

C.2 Characteristics of Type 3G glass-fibre reinforced bitumen perforated venting layer

C.2.1 Description

The Type 3G is a specific preparatory venting base layer, manufactured with a specially perforated base, which provides a method of controlled partial bonding when used in a built-up RBM system.

It is to be produced with nominal 25 mm diameter perforations, positioned at approximately 75 mm to 85 mm pitch throughout. A margin is normally provided to facilitate lapping of side joints.

It comprises a bitumen coated glass base (perforated as above) which is covered on the lower surface with granules, and on the upper face with fine sand surfacing to prevent the product sticking in the roll.

C.2.2 Details of Constituent Materials

Masses per unit area of constituent materials are as shown in Table C.1.

Base: The base of Type 3G bitumen membrane consists of a sheet of bonded glass fibres, which does not require saturating. Each test piece 50 mm wide has a breaking strength of not less than 150 N when tested to rupture.

Coating bitumen: The coating material has a softening point (ring and ball test) within the range 80 °C to 120 °C when tested in accordance with BS 2000-58, and consists of oxidized bitumen conforming to BS 3690-2, which can be stabilized with finely divided mineral filler. The proportion of mineral filler does not exceed 30% by mass of the coating material.

C.2.3 Uses

The Type 3G sheet is suitable for use as the first layer in built-up RBM roofing specifications when partial bonding and/or venting of the first working waterproofing layer is required.

C.2.4 Mass

The nominal mass per unit area of Type 3G membrane is to be 26 kg per 10 m^2 exclusive of wrappings or accessories. The mass of a roll is not less than 95% of that calculated from the nominal mass per unit area.

C.2.5 Standard packages

Type 3G sheets are supplied in rolls 1 m wide, and lengths of 10 m, unless otherwise specified. They are not colour coded.

Table C.1 **Mass per units area for constituents of Type 3G RBMs**

Type	**Nominal mass per unit area**	**Nominal length of roll**	**Nominal mass per unit area of base**	**Masses per unit area obtained by analysis**		
				Base min.	**Bitumen content min.**	**Surfacing material (nominal)**
	kg/10 m^2	m	g/m^2	g/m^2	g/m^2	g/m^2
3G glass-fibre reinforced bitumen venting base layer	26	10	60 (excluding effect of perforations)	55	690	250 (sand, upper face) 1 000 (granules, lower face)

Annex D (informative) Worked examples

D.1 Introduction

The following worked examples illustrate for five example roofs the preparation and selected VCL, thermal insulation, and waterproofing layers.

The selected insulations and materials/membranes should not be viewed as exclusive solutions, but as indicative of a minimum workable specification.

The factors affecting the specifier's selection will include:

- the type of roof deck;
- the required performance of the insulation;
- the ease of access to the roof;
- the extent of pedestrian traffic;
- the number of perforations/penetrations;
- the exposure rating of the building;
- the internal relative humidity; and
- the performance and reliability required for the waterproofing layers.

EXAMPLE 1: Single-storey rural school classroom

Building type	Single-storey rural school classroom	Low RH 3 m high, therefore accessible to vandals
Location	Outskirts of town	Medium exposure
Use/traffic	Easy access for maintenance, but also possibly for vandals	Simple access, therefore needs protection and reliability

Use the flow charts in Table 7 and Table 8 to choose the following parameters. The following items should not be considered as the only solution, but are as an example only.

Parameter	**Recommendation**	**Comments**
Deck	WBP plywood, 19 mm thick	Could also be oriented strand board (OSB)3, 19 mm thick
Deck preparation	150 mm wide taping strip laid loose over board joints and mopped over	To prevent ingress of hot bitumen and to isolate the membrane from differential movement at the board joints
Vapour control layer	RH low (or medium): fully bonded reinforced bitumen membrane with minimum SP values of S2P2	Suitably reinforced to accommodate movement of deck under moisture or temperature changes
Insulation system	e.g. rigid rock fibre/glass fibre boards	The insulation can be of any type within the flow chart. Rock fibre chosen to meet local authority requirements.
Preparation	None	
Underlay	Choose a two-layer system, where at least one layer has SP values of S4P5 and the other layer a minimum of S2P1	Pour-and-roll (for system continuity). Needs to resist traffic and vandalism, therefore the higher performance layer should be used as the capsheet.
Capsheet		
Surface finish	Integral mineral	
Detailing capsheet	Membrane with SP values of S3P3 mineral	

NOTE If a three-layer system is required due to expected traffic and possible damage, an additional layer of S2P1 can be included.

EXAMPLE 2: Three-storey block of flats/offices

Building type	Three-storey block of flats/offices	Medium RH 10 m to 12 m high
Location	City centre	Medium exposure
Use/traffic	Only rarely, for maintenance	Difficult access, therefore needs maximum reliability

Use the flow charts in Table 7 and Table 8 to choose the following parameters. The following items should not be considered as the only solution, but are as an example only.

Parameter	**Recommendation**	**Comments**
Deck	Reinforced concrete	Stable, but with specific movement joints. Typical of this type of building
Deck preparation	Remove lumps, etc., smooth off surface, prime and allow to dry	
Vapour control layer	RH medium: fully bonded S2P2 reinforced bitumen membrane	Polyester reinforced RBM is suitably robust for use under site conditions. Cellular glass does not usually require a VCL, as it has substantial vapour resistance. In this example, an RBM layer was used to provide immediate temporary waterproofing.
Insulation system	e.g. cellular glass	The insulation can be of any type within the flow chart. In this example, cellular glass was chosen as it provides a stable surface with low thermal movement.
Preparation	Seal surface cells with a hot bitumen floodcoat	
Underlay	Choose a two-layer system, where at least one layer has SP values of S4P4 and the other layer a minimum of S2P1	As the substrate is stable, the underlay could be glass-reinforced (S1P1), but polyester-reinforced (S2P1) has been chosen as more robust under site conditions. If the following layer is to be torch-applied, the first layer should be suitable to receive torch application.
Capsheet		Plain sanded finish. A pour-and-roll or torch-applied layer can be specified.
Surface finish	Bonded chippings	To ensure maximum F.AA fire rating under BS 476-3:2004 test
Detailing capsheet	Membrane with SP values of S3P3	Needs to be relatively flexible material to allow forming of details. Mineral finish.

EXAMPLE 3: Swimming pool

Building type	Swimming pool	Very high RH 12 m high
Location	Northumberland	Medium exposure
Use/traffic	Regular access for planned maintenance only	

Use the flow charts in Table 7 and Table 8 to choose the following parameters. The following items should not be considered as the only solution, but are as an example only.

Parameter	**Recommendation**	**Comments**
Deck	Profiled metal	
Deck preparation	Stitch all side laps, prime top flats (crowns) of profiles and allow to dry	
Vapour control layer	Two layer: first layer S3P2 RBM, bonded to deck top flats (crowns); second layer specialist foil-cored RBM, fully bonded to first layer	S3 needed to span the troughs. All side laps to be bonded over the top flats (crowns) of deck. All end laps to both layers to be carefully sealed.
Insulation system	PUR/cork composite	Cork upper surfaces will accept a fully bonded system, and is suitable for regular foot traffic.
Preparation	None	
Underlay Capsheet	Choose a two-layer system, where at least one layer has SP values of S4P4 and the other layer a minimum of S3P2	
Surface finish	Integral mineral	*Not* metal-faced due to possible corrosive discharge
Detailing capsheet	Membrane with SP values of S3P3 mineral minimum	Needs to be a relatively flexible material to allow forming of details. Mineral finish. *Not* metal-faced due to possible corrosive discharge.

EXAMPLE 4: Hospital refurbishment

Building type	Established city hospital	Medium RH 10 m high
Location	City	Medium exposure
Use/traffic	Frequent access for maintenance to air conditioning and other plant	Several trades likely

Use the flow charts in Table 7 and Table 8 to choose the following parameters. The following items should not be considered as the only solution, but are as an example only.

Parameter	**Recommendation**	**Comments**
Deck	Existing asphalt on RC deck	
Deck preparation	Clear/scarify chippings, cut and seal blisters, make good upstands, prime entire surface, and allow to dry	Upstand heights and cavity tray locations limit options for insulation
Vapour control layer	Fully bonded strip of type S2P2 RBM to perimeters and roof openings, to encapsulate new insulation boards	Option to lay a full VCL if asphalt is in poor condition
Insulation system	Tapered PUR/PIR system	Opportunity to improve insulation values and drainage falls with tapered insulation scheme
Preparation	Type 3G to provide a partial bond	
Underlay	Choose a two layer system, where at least one layer has SP values of S3P3 and the other has a minimum of S2P1 mineral	
Capsheet		System is required to achieve F.AA rating under BS 476-3:2004 test
Surface finish	Integral mineral	Additional, colour-contrasting S4P4 mineral layer, used to delineate and uprate all walkways and access areas
Detailing capsheet	S3P3 mineral	Needs to be a relatively flexible material to allow forming of details. Mineral finish.

EXAMPLE 5: Garage block (one of the rare occasions where an uninsulated flat roof is required, e.g. domestic garage, shed, porch or covered walkway)

Building type	Block of domestic garages	Low RH 3 m high (accessible to vandals)
Location	Housing estate	Low exposure
Use/traffic	Easy access for maintenance but also possibly for vandals	Simple access, hence need for protection and reliability

Use the flow charts in Table 7 and Table 8 to choose the following parameters. The following items should not be considered as the only solution, but are as an example only.

Parameter	**Recommendation**	**Comments**
Deck	Close-boarded timber	In good condition
Deck preparation	Correct any uneven planks and punch in nail heads	Smooth substrate required
Vapour control layer	None	No insulation envisaged
Insulation system	None	No insulation envisaged
Preparation	Nailed, torch-receivable RBM to meet S4P4	Required for nail retention, and to allow for torch-applied following layers
Underlay	Choose a two layer torch-applied system, where both layers have a minimum SP value of S2P1	Simple, swift installation without need for a bitumen boiler.
Capsheet		Where vandalism is perceived to be severe, specify a higher performance capsheet (e.g. S4P4)
Surface finish	Integral mineral	
Detailing capsheet	Torch-applied	As main capsheet. Ensure details are suitable for torch applied RBM.

NOTE Inverted warm roofs. *The only insulation suitable for use on an inverted roof is extruded polystyrene (XPS), therefore the insulation manufacturer's advice should be sought, along with the information in BS 6229.*

The waterproofing specification could be similar to the un-insulated roof in Example 5, but the top layer would have a sanded finish on flat areas (i.e. beneath the XPS boards). However, inverted roof membranes are rarely inspected due to the inconvenience of removing the ballast and insulation. Therefore, a more substantial system (such as that in Example 1) is advised.

Blank/model project working sheet for warm-decked roof

Building type		
Location		
Use/traffic		
Use the flow charts in Table 7 and Table 8 to choose the following parameters. The following items should not be considered as the only solution, but are as an example only.		
Parameter	**Recommendation**	**Comments**
Deck		
Deck preparation		
Vapour control layer		
Insulation system		
Preparation		
Underlay		
Top layer or capsheet		
Surface finish		
Detailing capsheet		

Blank/model project working sheet for inverted roof

Building type		
Location		
Use/traffic		
Use the flow charts in Table 7 and Table 8 to choose the following parameters. The following items should not be considered as the only solution, but are as an example only.		
Parameter	**Recommendation**	**Comments**
Deck		
Deck preparation		
Underlay		
Top layer or capsheet		
Insulation system		
Filter layer		
Ballast		
Surface finish		
Detailing capsheet		

Bibliography

Standards publications

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

BS 747:2000, *Reinforced bitumen sheets for roofing – Specification*

BS 5534, *Code of practice for slating and tiling (including shingles)*

Non-standards publications

[1] EUROPEAN COMMUNITIES. 89/106/EEC. Council Directive of 21 December 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to construction products. Luxembourg: Office for Official Publications of the European Communities, 1988.

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