Part 7

Roofs

Chapter 7.1

Flat roofs and balconies

CONTENTS

SCOPE

This Chapter gives guidance on meeting the Technical Requirements and recommendations for flat roofs and balconies with a fully supported continuous weatherproofing membrane.

DESIGN STANDARDS

7.1 - D1 Design shall meet the Technical Requirements

Design that follows the guidance below will be acceptable for flat roofs and balconies.

For the purposes of this Chapter:
- generally, a flat roof has a maximum slope of 10° from the horizontal; however, many flat roof systems can be used at greater pitches, in some cases up to vertical. Specifications for sloping roofs are generally the same as for flat roofs, but will require mechanical fixings to hold the materials in place
- "deck" is the structural substrate of a flat roof
- "decking" is the upper trafficked surface of a balcony (commonly a hardwood assembly laid onto the roof or substantial paving tiles bedded to the surface).

Note: Profile sheeted roofing acting as the waterproofing is outside the scope of this Chapter because it is discontinuous and not continuously supported.

STATUTORY REQUIREMENTS

7.1 - D2 Design shall comply with all relevant statutory requirements

Designs should be in accordance with relevant Building Regulations and other statutory requirements.

LOADBEARING STRUCTURE

7.1 - D3 Flat roofs and balconies, including associated elements such as support and guarding, shall be designed to resist the applied loading and have adequate durability

Structural design shall be undertaken in accordance with a recognised standard.

Items to be taken into account include:

(a) dead and imposed loads
Dead and imposed loads should be calculated in accordance with BS EN 1991-1-1, BS EN 1991-1-3 and BS EN 1991-1-4. Where a flat roof is to act as a roof terrace, roof garden or car parking area, appropriate provision should be made for the additional loadings. Intensive green roofs should only be used in conjunction with concrete decks.

(b) wind loads
Wind loads appropriate to the site should be calculated in accordance with BS EN 1991-1-4. The design should resist uplift from wind forces either by anchorage to the main structure or by being of sufficient weight to prevent lifting. Holding down straps, where required, should be provided at 2.0m centres (maximum) (see Sitework clause 7.1 - S5(d)).

(c) durability
Technical Requirement R3 states that the structure shall, unless specifically agreed otherwise in writing with NHBC, have a life of at least 60 years.

The use of timber in balconies should be limited tosecondary elements which in turn are supported by materials other than timber. Timber can be used in the following situations provided it has the appropriate durability - see Chapter 2.3 'Timber preservation (natural solid timber)':
- cantilevered solid timber joist balconies with a waterproof membrane above the joists
- open balcony constructions with timber decking. The decking may be supported on solid timber joists which in turn are supported by materials or components other than timber
- balustrading.

Timber should not be used for:
- gallows brackets supporting a balcony
- posts or columns supporting a balcony
- guard rails or their support.

7.1 - D4 Structural design shall be undertaken to a recognised standard to ensure that loads are transmitted to the supporting structure without undue movement

Items to be taken into account include:

(a) timber (where appropriate)
Structural design should be in accordance with one of the following:
- BS EN 1995-1-1
- appropriate load/span tables published by TRADA in support of Building Regulations and associated documents
- I-joists and metal web joists should be specified in accordance with the manufacturer's recommendations, but not used in situations where any part of the joist is exposed to external conditions.

Joist hangers should be the correct size for the timber joists being supported and meet with BS EN 845.

Pre-drilled vertical holding down straps should be at least one metre long, and 30mm x 2.5mm in cross section.

All mild steel straps and fixings should be protected against corrosion in accordance with Tables A.1 and A.2 of BS EN 845-1.

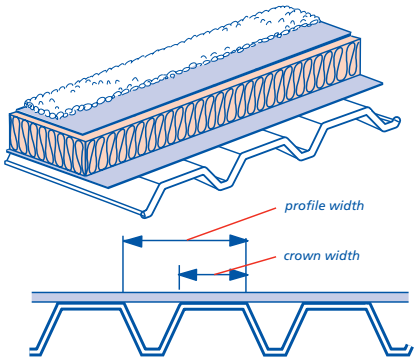
See clause 7.1 - D3 for guidance on the use of timber in balcony construction.

Reference should be made to Materials clause 7.1 - M1 and Chapter 2.3 'Timber preservation (natural solid timber)' (Design) for timbers requiring preservative treatment.

(b) in-situ reinforced concrete
In-situ reinforced concrete construction should be designed in accordance with BS EN 1992-1-1 and, where appropriate, Chapter 2.1 'Concrete and its reinforcement'. A concrete mix with low shrinkage characteristics should be specified.

(c) precast concrete
Precast concrete construction should be designed in accordance with BS EN 1992-1-1.
The design of concrete elements should allow for the following:
- continuity or anti-crack reinforcement
- allowance for movement at about 15m intervals and at abutments.

(d) profiled metal
The manufacturer's load/span tables for each profile should be consulted and should include the relevant applied safety factor. Profiled metals used for roof decks should have a profile with crowns of at least 50% of the profile width (not the sheet width) for bonded systems and 45% for mechanically fixed systems, in order to provide adequate support for the remainder of the roof build-up.



crown width to be not less than 50% of the profile width for bonded systems and 45% for mechanically fixed systems.

Construction loadings, including point loads imposed by foot traffic, storage of materials and loads imposed by following trades should be taken into account. Protection sheets, such as plywood, should be used to prevent damage if such loadings are expected.

Fixing to the structure should be in accordance with the manufacturer's instructions and BS EN 1991-1-4. Unless the manufacturer agrees otherwise, the deck should be side stitched to ensure it performs as a continuous plane layer.

The frequency of fixings should meet the manufacturer's recommendations, and be calculated to resist the wind uplift figures derived from BS EN 1991-1-4.

(e) structural steelwork
Structural steelwork should be designed in accordance with BS EN 1993-1-1 and

Technical Requirement R5. Supporting steelwork and purlins should be square, true and free from twists or sagging.

(f) differential movement
Allowance should be made for movement in larger roofs (e.g. roofs to blocks of flats), particularly where the span of the roof deck changes, e.g. in L-shaped buildings. Joints should be continuous through the vertical upstands, walls and edges of the building. Details are shown in Appendix 7.1-C.

(g) lateral restraint
Where walls require lateral restraint, this may be provided by joists and concrete roof elements. The bearings for concrete elements and timber joists where they are built in should be at least 90mm.

Where joists or concrete beams are parallel to walls, restraint straps at 2m centres (maximum) should be provided.

(h) sound transmission
Where the roof is a terrace above another dwelling, care should be taken to ensure that the design is in accordance with relevant Building Regulations.

PRINCIPLES OF DESIGN

7.1 - D5 Flat roofs shall be to a recognised design

Appendix 7.1-A shows the three flat roof constructions acceptable to NHBC with variations for timber and concrete structural support.

They are:

warm roof	-	concrete deck
	-	timber deck
	-	profiled metal deck
inverted warm roof	-	inverted concrete deck
green roof	-	intensive*
	-	extensive*

* A green roof should be a complete system from the membrane manufacturer and not individual components or materials.

The details for green roofs in Appendix 7.1-A are intended to be a guide and may vary depending on the individual manufacturer's system.

Cold roofs are not recommended, due to the difficulty of providing:
- an effective vapour control layer at ceiling level
- the required level of ventilation
- an unobstructed ventilation space above the insulation of 50mm
- ventilation at both ends of each joist void.

STRUCTURAL DECK

7.1 - D6 Flat roof decks shall be of adequate strength and moisture resistance

Deck materials suitable for the different types of roof design are given in Appendix 7.1-A.

THERMAL INSULATION AND VAPOUR CONTROL LAYERS

7.1 - D7 Flat roofs (and balconies functioning as roofs) shall have adequate thermal insulation

The BRE Report "Thermal insulation: avoiding risks" discusses aspects of insulation relevant to flat roofs and balconies. In England and Wales account should be taken of "Accredited Details".

Thermal insulation materials suitable for the different types of roof design are given in Appendix 7.1-A together with materials for vapour control layers and their position in the construction. The insulation material for inverted roofs should be suitable for external use and to withstand any anticipated traffic.

Where insulation is mechanically fixed the fixings should be of sufficient length to ensure they have adequate penetration into the supporting structure.

WATERPROOFING AND SURFACE FINISHES

7.1 - D8 Flat roofs (and balconies functioning as roofs) shall adequately resist the passage of moisture to the inside of the building

The roof coverings and surface finishes suitable for different types of roof design are given in Appendices 7.1-A, 7.1-B, 7.1-C, 7.1-D.

Appendix 7.1-A includes typical details suitable for the following:
- built-up Reinforced Bitumen Membrane (RBM) roofing (formerly called "felt")
- mastic asphalt roofing
- single-ply roofing systems
- green roofs (intensive and extensive).

Appendix 7.1-B includes details of surface treatments.

Appendix 7.1-C includes typical details for flat roofs and balconies.

Appendix 7.1-Dincludes guidance for balcony waterproofing and drainage.

GREEN ROOFS

Intensive and extensive green roofs are shown in Appendix 7.1-A. The details in Appendix 7.1-A are intended to be a guide and may vary depending on the individual manufacturer's system.

The manufacturer of the membrane system for a green roof should confirm that the overall roof design is compatible with the system. The complete green roof should be installed by a contractor trained and approved by the membrane manufacturer.

Once completed the waterproof membrane should be visually inspected and electronically tested for waterproofing integrity, faults rectified, and the roof re-tested before further layers, such as reservoir or filter layers and the subsoil and topsoil are placed. The tested membrane should be protected from damage until subsequent layers are applied.

The results of the test should be made available to NHBC.

The waterproofing for an intensive roof should be of reinforced bitumen membrane (RBM) or mastic asphalt and the design should include protection of the membrane from possible damage during maintenance of the garden e.g. from weeding/planting. A filter layer should be placed above the reservoir layer in accordance with the manufacturer's recommendations.

OTHER FLAT ROOF COVERINGS

These are given in Materials clause M1 and should be used in accordance with the following:
- zinc sheet CP143-5 'Code of Practice for sheet roof and wall coverings'
- copper sheet CP143-12 'Code of Practice for sheet roof and wall coverings'
- lead sheet BS 6915 'Design and construction of fully supported lead sheet roof and wall coverings'.

RAINWATER DRAINAGE

7.1 - D9 Flat roofs (and balconies functioning as roofs) shall have adequate rainwater disposal to a suitable outfall

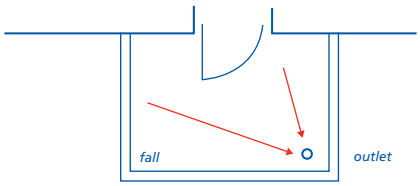
Items to be taken into account include:

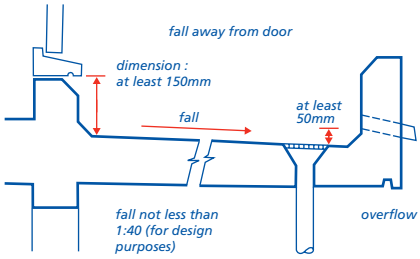
(a) falls

GENERAL

Other than the exceptions given below, all flat roofs (and balconies functioning as roofs) should be designed with a fall of not less than 1:40. A fall of 1:40 should be used for the design of flat roofs and balconies, unless a detailed analysis of the roof is carried out including overall and local deflection, to ensure the finished fall is not less than 1:80. Open slatted balcony decking should drain away from the dwelling.

Allowance for deflection should be made in the structural design where falls are achieved using screeds, particularly on large roofs.





Where decking or paving to a balcony is to be installed above the waterproofing but less than 150mm below the sill, it should be of a type and design that prevents a build-up of standing water (see Appendix 7.1-D).

TAPERED INSULATION TO ACHIEVE FALLS

Drainage falls to warm-decked roofs using tapered insulation should be designed by the insulation manufacturer, with falls of not less than 1:60. They should be laid directly onto the vapour control layer, with the primary waterproofing above. Cross-falls should be achieved using mitred joints.

METAL SHEET ROOFS

Flat roofs with metal sheet roof coverings should be designed with a fall of not less than 1:30 to ensure a finished fall of not less than 1:60.

GREEN ROOFS

Green roofs should be designed to retain some water, to support and nurture the vegetation, and to manage the run-off, but the waterproofing should have falls of not less than 1:60 or in accordance with the system manufacturer's recommendations.

(b) outlets

The size and number of outlets should be designed to meet the expected rainfall intensity in accordance with BS EN 12056-3. For flat roofs bounded by parapets at least two outlets (or one outlet plus an overflow) should be provided. Outlets should have a recessed mouth to allow the free flow of water.

Rainwater drainage design is covered in Chapter 7.2 'Pitched roofs'. Reference should be made to Chapter 5.3 'Drainage below ground', where necessary. The roof design should incorporate rainwater outlets from flat roofs that are accessible for maintenance. For green roofs an accessible and visible inspection hatch should be provided at every outlet.

(c) prevention of flooding

Where a flat roof or balcony has an upstand on all sides, an overflow outlet should be provided through parapet walls or perimeter upstands to prevent a build-up of water in the event of other outlets becoming blocked. The position and height of the overflow should be such that any build-up of water will not enter the building. The capacity of the overflow should not be less than the size of the outlet (or the aggregated capacity of the outlets, if there are several outlets).

GUARDING TO BALCONIES

7.1 - D10 Balconies and flat roofs to which persons have regular access other than for maintenance shall be guarded adequately

Items to be taken into account include:

(a) provision of guarding

Guarding should be designed as follows:

- the balustrading should not be easily climbed
- any glazing in the balustrading should be toughened or laminated glass or glass blocks
- balustrading should not be fixed through the waterproofing unless special precautions are taken (see Appendix 7.1-C).

(b) stability of guarding

Parapet walls and balustrading should be designed to resist horizontal loading as required by the relevant Building Regulations or BS EN 1991-1-1. Particular care is needed when the design incorporates balustrading fixed to parapet walls to ensure stability and prevent overturning. End fixings or returns may be needed to ensure stability.

In balcony walls (especially long balconies) the structural stability should be checked as the dpc at the base of the wall can create a slip plane that can seriously limit the ability of the wall to resist horizontal forces. In such cases, it may be necessary to incorporate a ring beam or other support to ensure stability.

In the design of parapet walls, movement should be allowed for. Reference should be made to Chapter 6.1. 'External masonry walls' clause D3(g).

ACCESS FOR MAINTENANCE

7.1 - D11 Adequate access shall be provided to flat roofs for the purpose of maintenance

Provision should be made for safe future access to flat roofs for the purposes of maintenance.

PROVISION OF INFORMATION

7.1 - D12 Designs and specifications shall be produced in a clearly understandable format and include all relevant information

Clear and fully detailed drawings should be available on site to enable work to be carried out in accordance with the design. The drawings should include:

- the specification for intensive or extensive green roofs
- extent and direction of falls and position of outlets
- sections through the construction indicating how the falls are formed, and means of ventilation, if required
- size, specification and position of all the roof components, including the vapour control layer, insulation and waterproofing layer
- all treatment and protection of materials to achieve the necessary durability
- details of construction at critical junctions
- details of balustrading and method of fixing
- details of fixing methods and fixings for insulation and surfacing.

7.1 - D13 All relevant information shall be distributed to appropriate personnel

Ensure that design and specification information is issued to site supervisors and relevant specialist subcontractors and/or suppliers.

MATERIALS STANDARDS

7.1 - M1 All materials shall:
(a) meet the Technical Requirements
(b) take account of the design

Materials that comply with the design and the guidance below will be acceptable for flat roofs and balconies.

Materials for flat roofs and balconies should comply with all relevant standards, including those listed below. Where no standard exists, Technical Requirement R3 applies (see Chapter 1.1 'Introduction to the Standards and Technical Requirements').

References to British Standards and Codes of Practice include those made under the Construction Products Directive (89/106/EEC) and, in particular, appropriate European Technical Specifications approved by a European Committee for Standardisation (CEN).

Appendix 7.1-A lists the materials suitable for:

- waterproofing, including flashings
- structure, deck and decking
- thermal insulation
- vapour control layer
- preservative treatment.

WATERPROOFING

7.1 – M2 Waterproofing materials shall be of adequate durability and resist the passage of moisture to the inside of the building

REINFORCED BITUMEN MEMBRANES, FORMERLY REFERRED TO AS "FELTS".
Only high performance reinforced bitumen membranes should be used, i.e. those including polyester reinforcement (e.g. Type 5U, 5B/180, 5E/250 to BS 747). Type 5 reinforced bitumen membranes are colour coded blue for identification.

SINGLE PLY MEMBRANES (THERMOPLASTIC)
Examples of single layer materials include PVC (polyvinyl chloride) and TPO (thermoplastic polyolefine).
These materials soften with increasing temperatures. Laps are welded, using either hot air or a specific solvent to melt and fuse them. These materials should be assessed in accordance with Technical Requirement R3.

LIQUID SYSTEMS
These materials are applied as a liquid, often laid in two or more coats. Most include a reinforcement scrim to distribute the tensile stresses.
- cold-applied flexible polyurethane systems
- hot melt rubberised bitumen systems.

These are applied hot in two 3mm coats, with reinforcement between, and with a substantial reinforced bitumen membrane protection sheet. They should only be used in buried applications, such as inverted roofs, green roofs, podium areas, etc. These materials should be assessed in accordance with Technical Requirement R3.

MASTIC ASPHALT
To BS 6925 type 988 T25, 20mm thick on the flat, laid on black sheathing felt.

For green roofs, three coats horizontally (30mm total thickness) and two coats vertically (20mm total thickness) are required.

Polymer modified asphalt waterproofing should be assessed in accordance with Technical Requirement R3.

Appendix 7.1-B gives suitable surface treatments for the waterproofing.

SHEET METAL
Materials should be in accordance with the following:
BS EN 501 'Specification for fully supported roofing products of zinc sheet
'BS EN 504 'Specification for fully supported roofing products of copper sheet'
BS EN 506 'Specification for self supporting products of copper or zinc sheet'
BS EN 12588 'Lead and lead alloys. Rolled lead sheet for building purposes'.

STRUCTURAL TIMBER

7.1 – M3 Structural timbers shall be of the appropriate grade and size to support the imposed loads

Items to be taken into account include:
- appropriate load/span tables published by TRADA in support of Building Regulations and associated documents
- structural softwood for internal use should be dry graded to BS 4978 and marked 'DRY' or 'KD'.

I-joists and metal web joists should be specified in accordance with the manufacturer's recommendations. They should not used in situations where any part of the joist is exposed to external conditions.

PROFILED METAL

7.1 – M4 Profiled metal roof decks shall be of the quality, type and dimensions required by the design

Profiled metal roof decks should be:
- galvanised steel to BS EN 10147 and used in compliance with BS EN 1993-1-3, or
- aluminium to BS EN 485-2.

GREEN AND PROPRIETARY ROOFS

7.1 – M5 Green roofs and proprietary roofing systems shall be suitable for their intended use

Green roofs, both intensive or extensive, should be a complete system from the membrane manufacturer and not individual components or materials.

The waterproofing for an intensive roof should be of reinforced bitumen membrane (RBM) or mastic asphalt.

The complete green roof should be installed by a contractor trained and approved by the membrane manufacturer.

Proprietary roofing systems, which do not meet with the principles given in Appendix 7.1-A, should be assessed in accordance with Technical Requirement R3.

SITEWORK STANDARDS

7.1 - S1 All sitework shall:
(a) meet theTechnical Requirements
(b) take account of the design
(c) follow established good practice and workmanship

Construction that complies with the design and the guidance below will be acceptable for flat roofs and balconies.

IN-SITU REINFORCED CONCRETE

7.1 - S2 In-situ reinforced concrete flat roofs shall be constructed to ensure they achieve the required design, strength and durability

Items to be taken into account include:
(a) accuracy of formwork
The formwork should be constructed accurately.

Items to take into consideration are:
- accurate location of holes
- adequate support
- proper allowance for placing of steelwork
- cast-in features, such as drips and weatherchecks
- surface finishes.

Where a metal deck is used as permanent shuttering, drying of the concrete will take place from the top surface only. A temporary roof should be provided to allow drying to take place. The permanent waterproofing should only be installed when the deck has fully dried.

(b) concrete grade
Reference should be made to Chapter 2.1 'Concrete and its reinforcement' for guidance on concreting. The design should have specified a concrete mix with low shrinkage characteristics.

PRECAST CONCRETE

7.1 - S3 Precast concrete flat roofs shall be constructed to ensure they achieve the required design, strength and durability

The supporting structure should:
- be even and true
- have a minimum 90mm bearing for the pre-cast units unless the design shows a lesser dimension.

Precast units should be:
- installed to provide an even surface
- grouted, where required by the design.

PROFILED METAL

7.1 - S4 Profiled metal flat roofs shall be constructed to ensure they achieve the required design, strength and durability

Items to be taken into account include:
(a) material type and protection against corrosion
Sheets should be checked for conformity with the design and specification when they are delivered to site.

(b) adequate storage
Profiled sheets should be stored to prevent:
- rusting of cut edges
- severe scratching of the galvanising
- sheets being bent or deformed.

(c) fixings
The number, type and location of fixings should in accordance with the design and specification.

(d) installation
The supporting steelwork and purlins should be square, true and free from twists or sagging. Unless the manufacturer agrees otherwise, deck materials should be side stitched to ensure the deck performs as a continuous plane layer.

Assembly of the roof, end laps, etc. should be in accordance with the design; any variation from this should be approved by the designer.

Protection sheets, e.g. plywood, should be used in areas of the roof deck subjected to construction loadings, including point loads imposed by foot traffic and storage of materials. Loads imposed by following trades should be taken into account.

Any deformed sheets should be stripped and replaced, before the waterproofing and insulation system is installed.

TIMBER

7.1 - S5 Timber flat roofs and (where appropriate) balconies shall be constructed to meet the required design,strength and durability

Items to be taken into account include:

(a) grades and sizes of joists
Materials delivered to site should be checked for conformity with the design and specification.

(b) the spacing and bearing required to achieve reasonably level support for firrings and deck
Timber joists should be:
- level - where necessary, hard packing should be used, e.g. tiles or slates bedded in mortar. Loose or soft packing, including timber, should not be used
- spaced at the centres specified on the drawing (not more than 600mm centres).

The use of regularised timber joists will help to achieve a level deck.

(c) strutting
Strutting should be one of the following:
- herringbone type (timber 38mm x 38mm)
- solid blocking (38mm thick timber x¾ depth of joist)
- proprietary steel strutting.

Strutting should be located as follows:

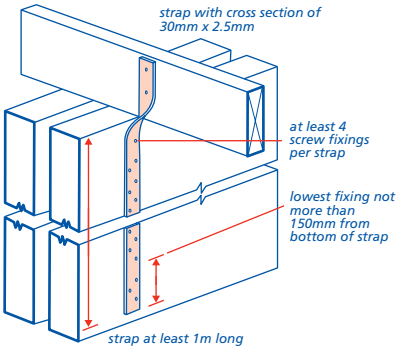
Joist span [m]	Rows of strutting
Up to 2.5	none needed
2.5 to 4.5	1 (at centre of span)
Over 4.5	maximum 2.5m centres, Spaced equally along the span

In cold deck roofs, the strutting should not prevent free cross ventilation.

(d) holding down metal strapping
If the design specifies holding down straps to prevent the roof being lifted off the supporting structure, they should be at 2.0m centres (maximum).

Where straps are fixed to masonry, hardened nails 4mm in diameter x 75mm long or No 12 wood screws x 50mm long into plugs should be used.

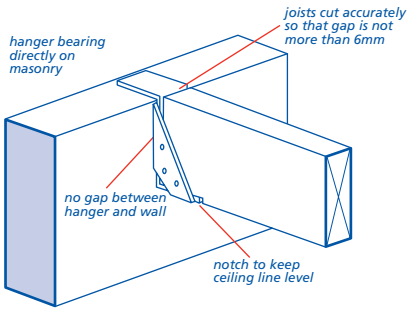
The number of fixings should be in accordance with design requirements and the lowest fixing should be within 150mm of the bottom of the vertical strap.



(e) timber quality
Timber should be rejected if it:
- is excessively bowed, twisted or cambered
- is excessively wet
- has large edge knots or shakes
- has a waney edge more than half the thickness
- has fissures
- has any sign of rot.

Where preservative treated timber has been cut after treatment the cut edges should be re-treated with a coloured preservative.

(f) joist hangers
The joist hanger should be the correct size for the timber joist or trimmer and nailed in accordance with the design.
The masonry course to carry the joist hangers should be level and at the correct height. The walling should not becut into.



STRUCTURAL DECKS

7.1 - S6 The structural deck shall be installed to form a satisfactory substrate for the waterproofing system

Items to be taken into account include:

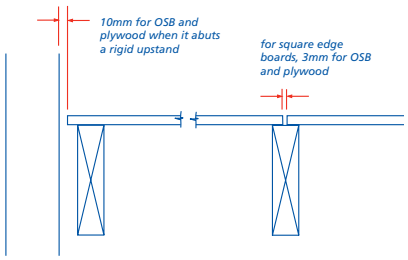
(a) fixing of plywood and oriented strand board
Tongued and grooved boards laid either with the long edge at right angles to the joists or parallel to the joists should have the short edge supported on a joist or nogging.

Oriented strand board should be laid over supports in the direction indicated on the boards. The stronger axis should be laid at right angles to the supporting joists.

Roof perimeter edges of boards which do not coincide with joists should be supported on noggings.

Unless the design specifies closer centres oriented strand board and plywood fixing centres should not exceed 100mm.

Movement gaps at abutment with rigid upstands should be not less than 10mm and gaps between square edge boards should not exceed 3mm.



Oriented strand board should be fixed with flat headed ring shank nails, 3mm in diameter at least 2½ x board thickness long and not less than 9mm from the edge of the board.

Plywood should be fixed with ring shank nails, at least 50mm long x 3mm in diameter.

(b) fixing of softwood boarding
Softwood tongued and grooved boarding should be closely clamped together. Each board should be nailed with two ring shank nails to each joist or firring. Nail heads

should be punched below the timber surface. End joints should be staggered.

(c) protection of structural deck
The deck should be installed in dry conditions and be protected from wetting until the roof is complete. The joints in sheet materials which are pre-felted or coated should be sealed immediately after fixing.

The area of deck installed in any working day should be no greater than can be quickly protected from wetting.

Damaged materials and materials that have been adversely affected by moisture should be discarded.

DRAINAGE

7.1 - S7 Flat roofs shall have effective drainage

Falls and gutters should be constructed in accordance with the design. Flat roofs and balconies should have a finished fall of not less than 1:80 except flat roofs with metal sheet roof coverings and green roofs which should have a finished fall of not less than 1:60.

Appendix 7.1D provides guidance on weatherproofing and drainage of balconies

Items to be taken into account include:

(a) falls on concrete roofs

CEMENT/SAND SCREEDS

Cement sand screeds should be 1 : 4, cement : sand. Minimum screed thicknesses should be as follows:

Location of screed	Thickness [mm]
Bonded monolithically to insitu or pre-cast concrete	nominally 40mm (25mm minimum)
Unbonded (on separating layer)	nominally 70mm (50mm minimum)

Reference should be made to Chapter 8.3 'Floor finishes' for further guidance on laying screeds.

LIGHTWEIGHT SCREEDS

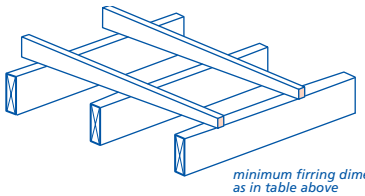
Lightweight screeds should be laid only by specialist contractors. Lightweight concrete screeds should have a topping of 1 : 6, cement : sand, 13mm thick.

SCREED FINISH

Screeds should be free from ridges and indentations. They should be finished with a wooden float to provide a smooth, even surface for the vapour control layer and waterproof finish.

(b) falls on timber roofs
Firring pieces should be used to form falls, unless the design shows sloping joists and ceiling. Where laid across the joists, firrings should be not less than the following sizes:

Joist Centres [mm]	Minimum firring dimensions [mm]	
	width	depth
400 or 450	38	38
600	38	50



minimum firring dimensions as in table above

(c) tapered insulation systems
The manufacturer's specific design and layout drawings should be followed. The sequence of installation should ensure that boards are waterproofed and the roof sealed at the end of each day, or before the arrival of inclement weather. Successive roof layers should be laid with a minimum of delay, to avoid trapping water during construction.

(d) access to rainwater outlets
Rainwater outlets from flat roofs should be accessible. For green roofs an accessible and visible inspection hatch should be provided at every outlet.

THERMAL INSULATION AND VAPOUR CONTROL LAYERS

7.1 - S8 Insulation and vapour control layers shall be installed in accordance with the design

Appendix 7.1-A gives details of suitable materials for insulation and vapour control layers for the different types of roof designs.

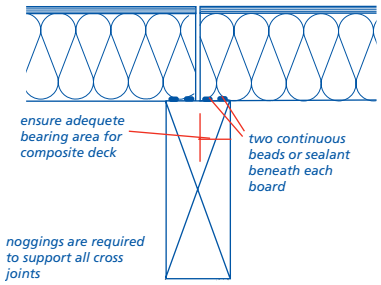
WARM ROOFS

The design should indicate that the vapour control layer is below the insulation and that it is sealed to the waterproofing at the perimeter and at all penetrations through the roof, e.g. at outlets and pipes. In single ply roofing systems the vapour control layer is generally not sealed to the waterproofing.

Insulation boards should be kept dry at all stages to prevent:
- lack of bonding
- trapping of moisture.

The area of insulation laid at any time should be that which can quickly be covered by the waterproofing or protected from wetting.

Insulation should be bonded or mechanically fixed inaccordance with the manufacturer's recommendations.



Composite decks require noggings under transverse edges. The joist width should be in accordance with the design to ensure the insulation has adequate bearing.

The foil underface of a composite deck should be sealed with two beads of sealant along all board joints to maintain the integrity of the vapour control layer.

INVERTED ROOFS

The insulation material for inverted roofs should be in accordance with the design, be suitable for external use and withstand any anticipated traffic.

GREEN ROOFS

Where the vapour control layer has been used as a temporary waterproofing layer any damage should be repaired using a full width section of membrane.

COLD ROOFS

Ventilation should be provided at both ends of each joist void, and should not be blocked by the thickness of the insulation.

A minimum of 50mm clear air space above the insulation should be maintained.

WATERPROOFING

7.1 - S9 Waterproofing shall prevent water entering the building

Items to be taken into account include:

(a) preparation of surfaces
The structure and the surface to receive the waterproofing should be checked and approved by the waterproofing contractor. All nails should be well punched below the surface, which should be even and dry.

The manufacturer's recommendations on priming upstands, roof outlets, etc. should be followed to achieve a satisfactory bond with the waterproofing.

(b) construction sequence
Waterproofing systems should be laid in accordance with the design and specification following the recommendations of the manufacturer. Some proprietary systems should be laid only by specialist roofing contractors

approved by the manufacturer. See clause S9(d) for green roofs.

It is preferable for one contractor to lay the vapour control layer, the insulation, the waterproofing and the surface finish. The contractor should ensure that the deck and the insulation boards are waterproofed and the roof sealed at the end of each day, or before the arrival of inclement weather.

Successive roof layers should be laid so as not to trap water during construction.

Membrane laps near outlets should not impede drainage.

(c) weather conditions
The manufacturers' recommendations for conditioning, (unrolling in advance of laying, etc) should be followed.

Generally, sheet membranes should not be laid or handled when the air temperature is 5°C or below unless the manufacturer agrees otherwise. Some self-adhesive reinforced bitumen membranes should not be laid below 10°C. For such systems, the manufacturer's specific instructions should be followed.

Membranes should not be laid on damp or frosted surfaces or when any rain, sleet or snow is falling.

(d) green roofs
Green roofs should be laid in accordance with the design and the membrane manufacturer's recommendations, taking into account:
- root barriers
- height of upstand in relation to soil height and flashings
- integrity of waterproofing prior to burying
- protection, reservoir and filter layers
- moisture control of the soil.

Green roof systems should be installed by operatives who:
- are competent
- are familiar with the system being installed
- hold a certificate confirming they have been trained by the system membrane manufacturer or distributor.

(e) correct detailing
Appendix 7.1-C gives, for the different roof types, typical details of:
- abutments
- parapets
- edge details
- fixing of guarding
- projections through the waterproofing
- roof lights.

(f) balconies
Appendix 7.1D provides guidance on weatherproofing and drainage of balconies

GUARDING TO BALCONIES

7.1 - S10 Guarding to balconies shall be of adequate strength and height to minimise the risk of people falling, of adequate durability and fixed securely

Items to be taken into account include:

(a) strength and movement of masonry balcony walls
Masonry balcony walls should be built in accordance with Chapter 6.1 'External masonry walls'. In particular:
- walls should incorporate strengthening as required by the design
- movement joints should be provided in accordance with the design
- copings should be firmly bedded.

(b) fixing of balustrading and guard rails
Balustrading and guard rails should be fixed in accordance with the design details. Reference should also be made to Appendix 7.1-C.

PROTECTION OF MATERIALS FROM WEATHER

7.1 - S11 Moisture sensitive material shall be protected from wetting

Timber-based roof decking and insulation materials should be stored under cover to prevent wetting.

Timber-based roof decks that have been fixed in position should be temporarily covered to prevent wetting, unless the waterproofing is to be laid immediately.

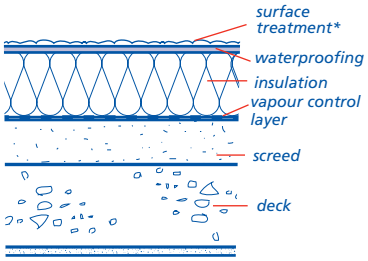
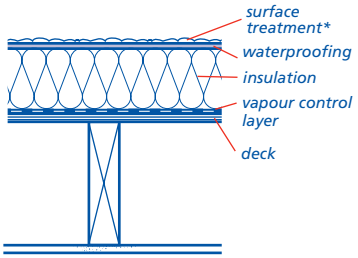
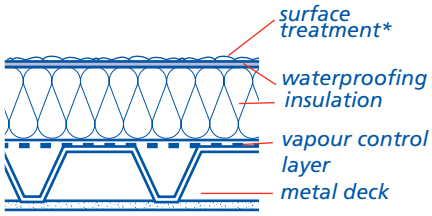
Zinc coils and sheets should be stored in dry conditions before being installed.

APPENDIX 7.1-A

Commonly used flat roofs

Three types of flat roof are shown here to illustrate the principles of their design:

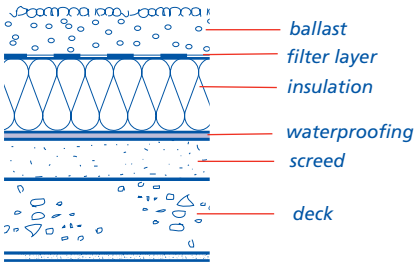
WARM ROOF (insulation on top of deck)

concrete deck	timber deck	profiled metal deck
		

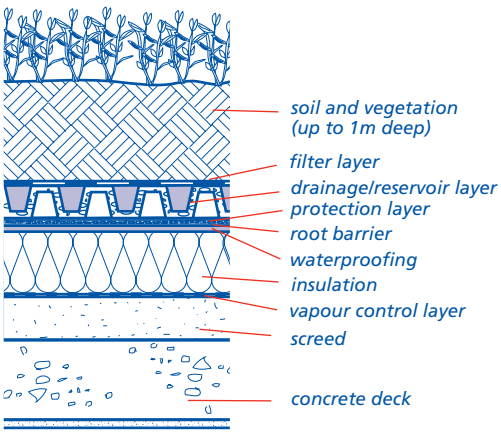
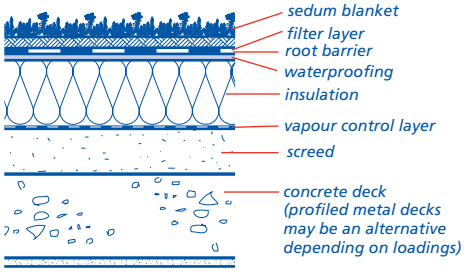
* mineral surfaced or solar reflective treatment where required

INVERTED WARM ROOF (insulation on top of waterproofing)

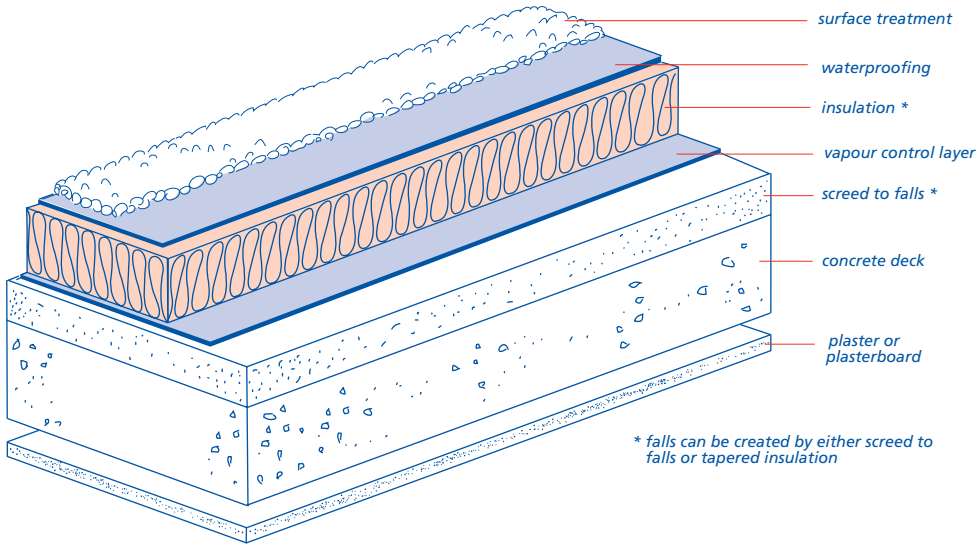
concrete deck



GREEN ROOF

intensive (requires regular maintenance. Plants contained within soil)	extensive (requires periodic maintenance. Plants generally contained in the sedum blanket
	

WARM ROOF (concrete deck)



Surface treatment
See Appendix 7.1-B

Waterproofing and insulation
Waterproofing should be one of the following:
- reinforced bitumen membrane (RBM) to BS 8747 from the following table:

Type of Reinforced Bitumen Membrane (RBM)			Insulation material	Method of fixing first layer
First/preparatory layer	**Second layer/underlay**	**Final layer/cap sheet**		
Type 3G perforated layer	S2P3	S5P5 with either integral mineral finish or separate solar protection	Rigid Urethane Foam (RUF) boards (polyurethane (PU) and polyisocyanurate (PIR)	Loose laid and lapped, to produce partial bonding.
Type 3G perforated layer	Elastomeric underlay achieving S2P3	Elastomeric capsheet achieving S5P5		
S2P3 fully bonded	S2P3	S5P5 with either integral mineral finish or separate solar protection	Compressed cork, rock fibre or glass fibre boards, cellular glass slabs, perlite boards, or composite products	Full bitumen bonding, per BS 8217
S2P3 fully bonded	Elastomeric underlay achieving S2P3	Elastomeric capsheet achieving S5P5		
Note: torching onto insulation boards, except rock/glass fibre or perlite is not acceptable. Note: Elastomeric (i.e. SBS polymer-modified) bitumen membranes, with greater extensibility and flexibility, especially at low temperatures, are likely to provide longer service life.				

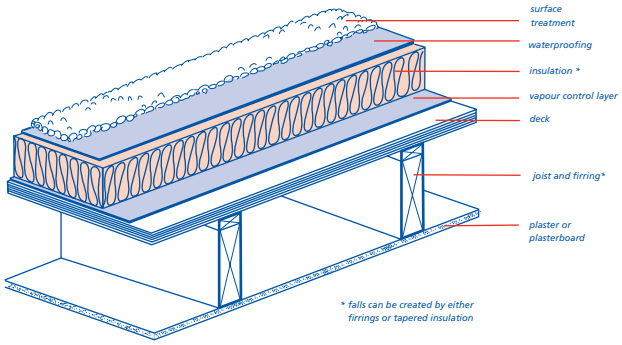
- mastic asphalt, 20mm thick on the flat, laid in two layers, all to BS 8218 onto black sheathing felt
- a thermoplastic single ply membrane, assessed in accordance with Technical Requirement R3, either bonded to the insulation, mechanically fixed to the deck through the insulation, or loose-laid, sealed and ballasted. Refer to the manufacturer's instructions for details.

Vapour control layer
The vapour control layer should consist of at least one layer of bitumen roofing membrane (S2P3) fully bonded to the structural deck and all laps sealed with bitumen.

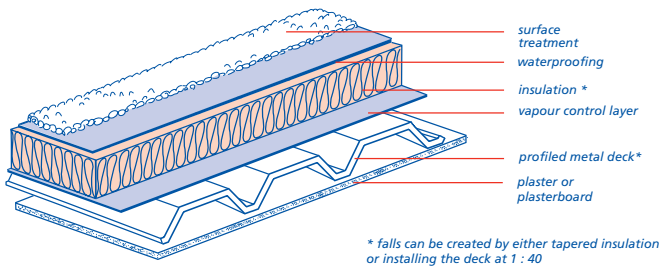
Concrete deck and screed
Concrete roof deck, suitably primed, with sand/cement screed topping to achieve the falls. The screed should be in accordance with Clause 7.1-S7(a).

Detailing
Typical details are shown in Appendix 7.1-C.

WARM ROOF (timber deck)



WARM ROOF (profiled metal deck)



Surface treatment
See Appendix 7.1-B

Waterproofing and insulation
Waterproofing should be one of the following:

- reinforced bitumen membranes (roofing felt) to BS 8747 from the following table:

Type of Reinforced Bitumen Membrane (RBM)			Insulation material	Method of fixing first layer
First/ preparatory layer	Second layer/ underlay	Final layer/ cap sheet		
Type 3G perforated layer	S2P3	S5P5 with either integral mineral finish or separate solar protection	Rigid Urethane Foam (RUF) boards (polyurethane (PU) and polyisocyanurate (PIR)	Loose laid and lapped, to produce partial bonding
Type 3G perforated layer	Elastomeric underlay achieving S2P3	Elastomeric capsheet achieving S2P3		
S2P3 fully bonded	S2P3	S5P5 with either integral mineral finish or separate solar protection	Compressed cork, rock fibre or glass fibre boards, cellular glass slabs, perlite boards, or composite products	Full bitumen bonding, per BS 8217
S2P3 fully bonded	Elastomeric underlay achieving S2P3	Elastomeric capsheet achieving S2P3		
Note: torching onto insulation boards, except rock/glass fibre or perlite is not acceptable. Note: Elastomeric (i.e. SBS polymer-modified) bitumen membranes, with greater extensibility and flexibility, especially at low temperatures, are likely to provide longer service life.				

- mastic asphalt, 20mm thick on the flat, laid in two layers, all to BS 8218 onto black sheathing felt
- a thermoplastic single ply membrane, assessed in accordance with Technical Requirement R3, either bonded to the insulation, mechanically fixed to the deck through the insulation, or loose-laid, sealed and ballasted. Refer to the manufacturer's instructions for details.

Vapour control layer
In bonded systems the vapour control layer should consist of at least one layer of bitumen roofing membrane (S2P3) fully bonded or nailed to the structural deck and all laps sealed with bitumen. In mechanically fixed systems the vapour control layer should consist of suitable polyethylene sheet sealed at all laps.

Preservative treatment
All roof timbers, joists, wall plates, blocking, strutting, battens, firrings, noggings to be preservative treated, unless naturally durable. Chapter 2.3 'Timber preservation (natural solid timber)' gives details of preservative treatments.

Deck
Timber or timber-based decks should be one of the following:

Material	Thickness of deck (mm)	
	Joist centres (mm)	
	450mm	600mm
Pre-treated plywood, WBP grade	15	18
Marine plywood, WBP grade	15	18
Oriented Strand board Type OSB3	15	18
Pre-treated timber planking - tongue and grooved ('close boarded timber') Max. board width 100mm.	19	19

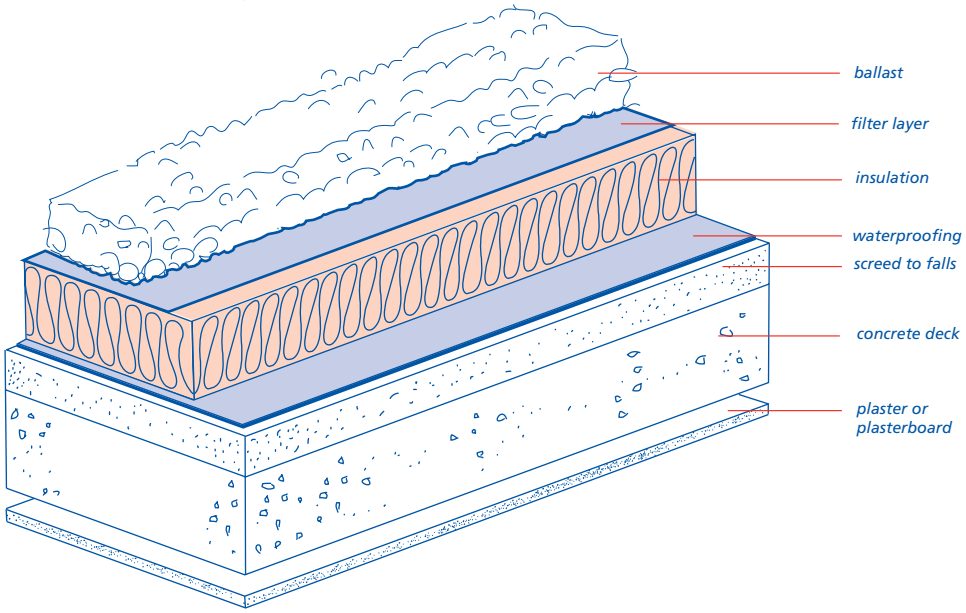
Reference should be made to Sitework clause 7.1 - S6 for fixing of the deck to joists.

Joists
For sizes and spacing, reference should be made to appropriate load/ span tabales published by TRADA in support of Building Regulations and associated documents.

Detailing
Typical details are shown in Appendix 7.1-C

INVERTED WARM ROOF (concrete deck)

(NOT suitable for slopes greater than 10°)



Ballast
Ballast should consist of paving slabs, or of rounded pebbles of minimum diameter 19mm to the depth specified in the design.

Filter layer
Geo-textile layer, laid over insulation boards to prevent fines from reaching the membrane surface.

Insulation
Insulation should be of a type unaffected by exposure to the weather and capable of supporting the weight of the ballast. Only the following materials are suitable:
- extruded polystyrene (XPS)
- extruded polystyrene, with cementitious surface.

Waterproofing
Waterproofing should be one of the following:
- reinforced bitumen membranes (roofing felt) to BS 8747 from the following table:

Type of Reinforced Bitumen Membrane (RBM)			Deck material	Method of fixing first layer
First/preparatory layer	**Second layer/ underlay**	**Final layer/cap sheet**		
Type 3G perforated layer	S2P3	S5P5 with either integral mineral finish or separate solar protection	Concrete, or concrete with sand/ cement screed	Loose laid and lapped, to produce partial bonding
Type 3G perforated layer	Elastomeric underlay achieving S2P3	Elastomeric capsheet achieving S2P3 Mineral surfaced on exposed upstands, etc.		
Note:Concrete or screeded substrates should be adequately dry to receive waterproofing system Note: Elastomeric (i.e. SBS polymer-modified) bitumen membranes, with greater extensibility and flexibility, especially at low temperatures, are likely to provide longer service life				

- mastic asphalt, 20mm thick on the flat, laid in two layers, all to BS 8218 onto black sheathing felt.
- a thermoplastic single ply membrane, assessed in accordance with Technical Requirement R3, either bonded or mechanically fixed to the deck, or loose-laid, sealed and ballasted. Refer to manufacturer's instructions for details.

Concrete deck and screed
Concrete roof deck, suitably primed, with sand/cement screed topping to achieve the falls. The screed should be in accordance with Clause 7.1-S7(a).

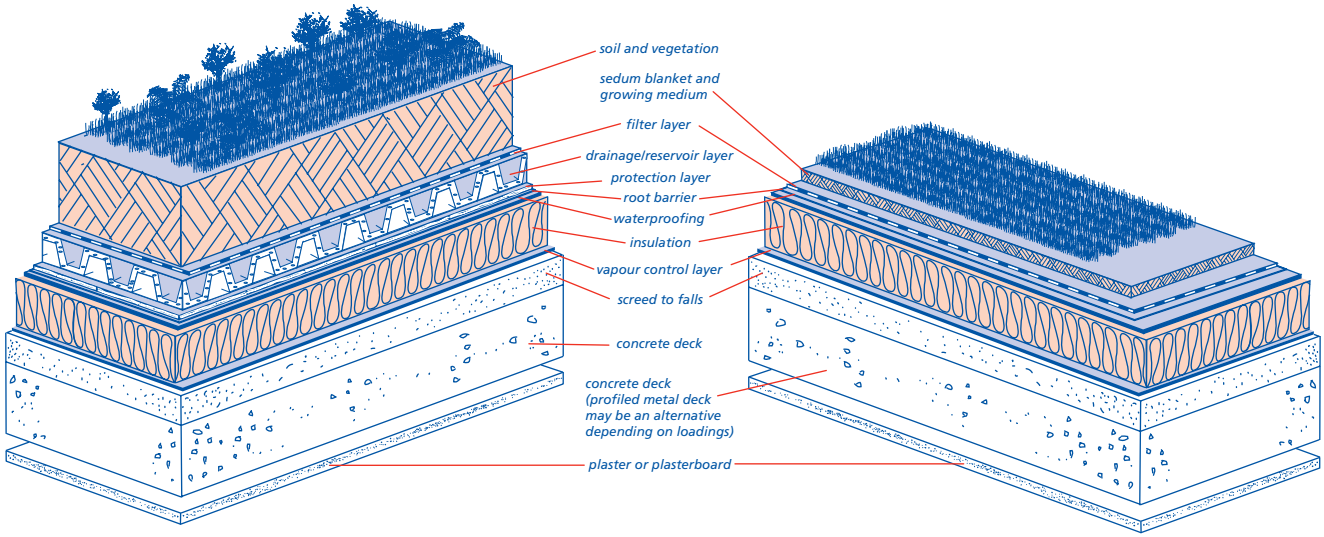
Detailing
Typical details are shown in Appendix 7.1-C.

Note:
Inverted roofs should only be used with timber (solid or I-joist) or metal profiled decks if they have been designed to support the loads, particularly from the depth of ballast needed to retain the insulation material.

GREEN ROOF

A green roof, either intensive or extensive, should be a complete system from the membrane manufacturer and not individual components or materials. The details given below are intended to be a guide and may vary depending on the individual manufacturers system. The following identifies the two types of green roof:

INTENSIVE **EXTENSIVE**



Summary	Intensive	Extensive
Feature	requires regular "intensive "maintenance e.g. similar to a normal garden provides a normal garden environment uses natural topsoil at least 150mm deep and normal plants	requires minimal maintenance e.g. annual attention a sedum blanket contains the plants
Structure	roof design to allow for full weight of wet soil 20° maximum roof pitch	roof loadings less than Intensive roof
Falls and moisture control	drainage falls 1:60min irrigation system may be required to support plants in dry spells	45° maximum roof pitch drainage falls 1:60min irrigation system may be required to support plants in drought conditions
Vapour control layer	Fully bonded polyester-reinforced RBM (S2P3)	Fully bonded polyester-reinforced RBM (S2P3)
Insulation	Insulation material to have adequate compressive strength to withstand likely applied loads Where the insulation is above the weatherproofing, only extruded polystyrene (XPS) should be used	Insulation material to have adequate compressive strength to withstand likely applied loads Where the insulation is above the weatherproofing, only extruded polystyrene (XPS) should be used
Waterproofing	See separate table. A root resistant element such as a copper foil or "Preventol "treatment is required above the waterproofing membrane	See separate table. A root resistant element such as a copper foil or "Preventol "treatment is required above the waterproofing membrane
Protection and filter layers	A filter layer and protection layer (or board), above the waterproofing membrane, is required to prevent damage. These to be in accordance with the manufacturer's recommendations	A filter layer and protection layer (or board), above the waterproofing membrane, is required to prevent damage. These to be in accordance with the manufacturer's recommendations

Type of Reinforced Bitumen Membrane (RBM)			Insulation Material	Method of fixing firstlayer
First/preparatory layer	**Second layer/ underlay**	**Final layer/cap sheet**		
Type 3G perforated layer	S2P3	S5P5 with either integral mineral finish or separate solar protection	Rigid Urethane Foam (RUF) boards (polyurethane (PU) and polyisocyanurate (PIR))	Loose laid and lapped, to produce partial bonding.
Type 3G perforated layer	Elastomeric underlay achieving S2P3	Elastomeric capsheet achieving S2P3 Mineral surfaced on exposed upstands, etc.		
S2P3 fully bonded	S2P3	S5P5 with either integral mineral finish or separate solar protection	Compressed cork, rock fibre or glass fibre boards, cellular glass slabs, perlite boards, or composite products	Full bitumen bonding, per BS 8217
S2P3 fully bonded	Elastomeric underlay achieving S2P3	Elastomeric capsheet achieving S2P3 Mineral surfaced on exposed upstands, etc.		
Note: torching onto insulation boards, except rockwool or perlite is not acceptable. Note: Elastomeric (i.e. SBS polymer-modified) bitumen membranes, with greater extensibility and flexibility, especially at low temperatures, are likely to provide longer service life.				
Mastic Asphalt Mastic asphalt to BS 8218. Three coat horizontally (30mm total thickness), two coat vertically (20mm total thickness).				

APPENDIX 7.1-B

Surface treatments

	Maintenance only for roofs up to 10°	Access roof, walkway or terrace deck	Further information may be obtained from
Reinforced Bitumen Membranes (RBM)	• mineral surfaced capsheets (e.g. Type S5P5) or reflective stone chippings, bedded in a dressing compound, or • a suitable thickness of washed, rounded 20 - 40mm shingle ballast laid loose	• pre-cast semi porous concrete tiles bedded in bitumen or other approved adhesive, or • pre-cast concrete proprietary paving slabs on supports or sand/cement blinding[2], or • proprietary timber decking systems 3	Flat Roofing Alliance www.fra.org.uk/
Mastic Asphalt	• reflective stone chippings 1, bedded in a bitumen based compound, or • a solar reflective paint, as approved by the Mastic Aphalt Council	• pre-cast semi porous concrete tiles bedded in bitumen or other approved adhesive, or • pre-cast concrete proprietary paving slabs on supports or sand/cement blinding[2]	Mastic Asphalt Council www.masticasphaltcouncil.co.uk/
Thermoplastic Single Ply Membranes	• products do not require supplementary solar reflective coatings or other finishes • where laid loose, membranes can be ballasted with suitable thickness of washed, rounded 20-40mm shingle ballast laid on a non-woven polymeric protection layer	• proprietary flexible, non-slip walkway sheets or tiles, compatible with the membrane product • pre-cast concrete proprietary paving slabs on adjustable supports or suitable non-woven polymeric protection layer • proprietary timber decking systems with bearers set on additional membrane or suitable non-woven polymeric protection layer	Single Ply Roofing Association www.spra.co.uk/

Notes

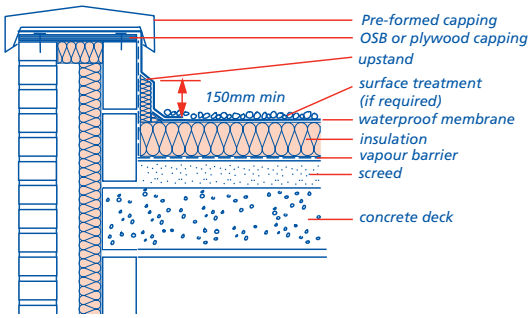
1 Loose surface finishes should be prevented from being removed by weather and discharged into gutters and drain pipes. Chippings should be not less than 12.5mm limestone or white spar, not pea gravel.
2 Cement/sand blinding should be laid on two layers of waterproof building paper or two layers of 1000 gauge polyethylene separating membrane. The slabs should be kept back 75mm at perimeters and a 25mm movement gap incorporated for every 9m² of paving laid.
3 Timber decking systems should only use compatible preservative treatments. The undersides of the bearers should have large, smooth contact areas, with no sharp edges or corners.

APPENDIX 7.1-C

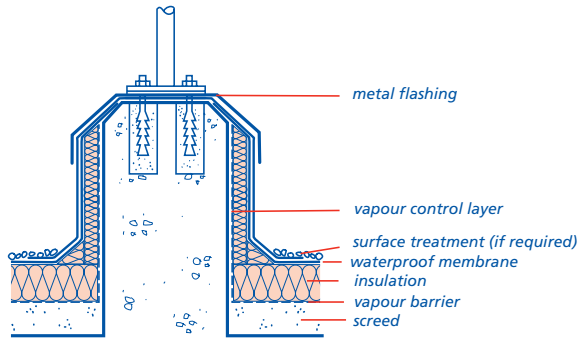
Construction details for flat roofs and balconies

This Appendix contains common details for flat roofs and balconies. The following sketches show examples of typical common construction details and illustrate general principles. Further information on specific waterproofing systems may be obtained from BS 8217 'Reinforced bitumen membranes for roofing - Code of Practice', the Flat Roofing Association, Mastic Asphalt Council or Single Ply Roofing Association.

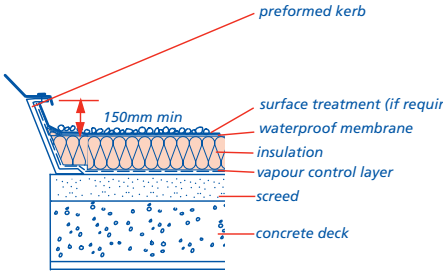
CONCRETE DECK



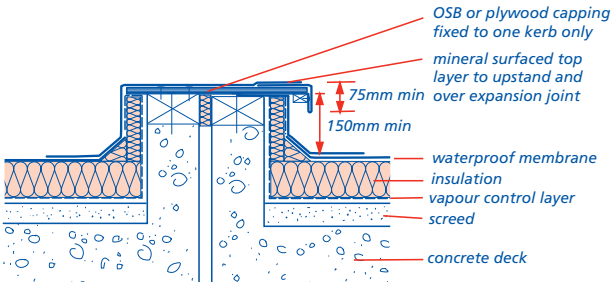
Upstand
- upstand may be fixed to wall
- upstand to be at least 150mm high
- similar details apply to inverted roofs with concrete decks



Handrail fixing
- upstand should be formed in concrete roofs

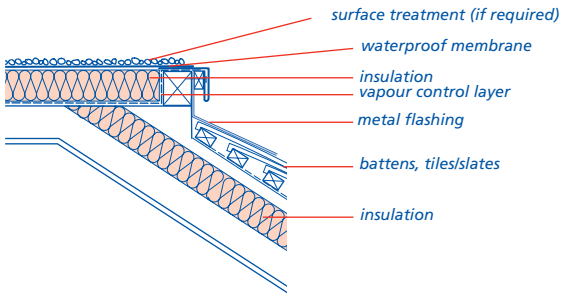


Skirting to rooflight or ventilator kerb
- similar details apply to inverted roofs. Allow for thickness of ballast to achieve upstand dimension.

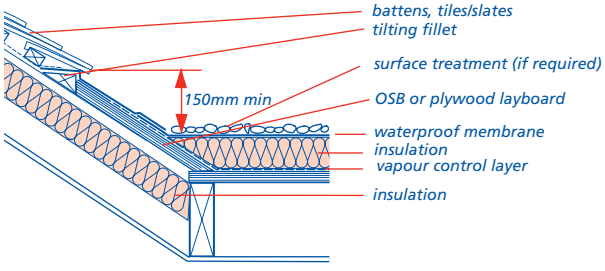


Twin-kerb expansion joint
- expansion joint is similar for both warm and inverted concrete roofs.

TIMBER DECK

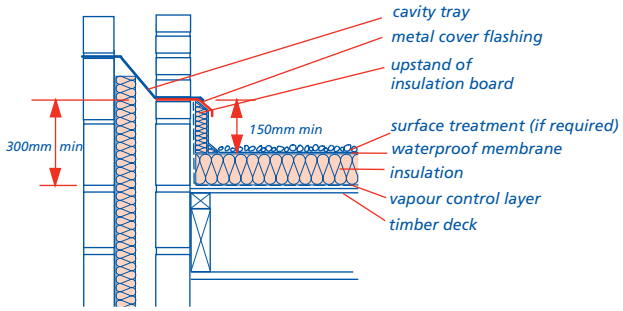


Mansard edge
- All elements should be firmly fixed to prevent peelback in high winds

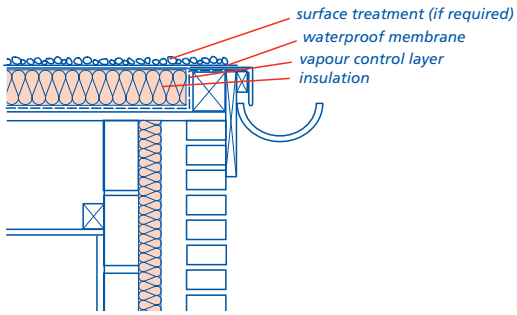


Pitched roof abutment

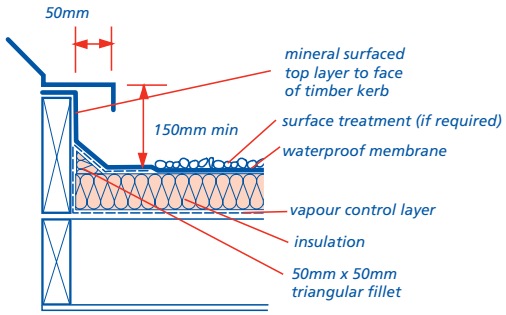
TIMBER DECK (Continued)



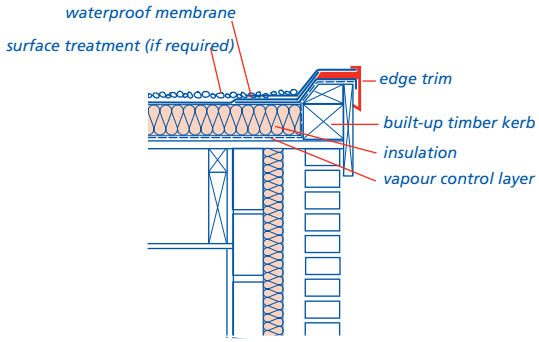
Independent skirting detail
- upstands should be kept separate from wall - allow for movement
- upstand should be at least 150mm high
- similar details apply to cold deck timber roofs



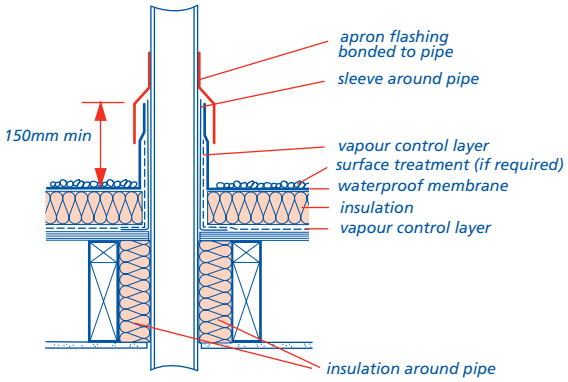
Welted drip to external gutter
- similar details apply to cold deck timber roofs
- inverted timber decks need special consideration to avoid insulation being lifted by wind suction. An alternative detail should be used.



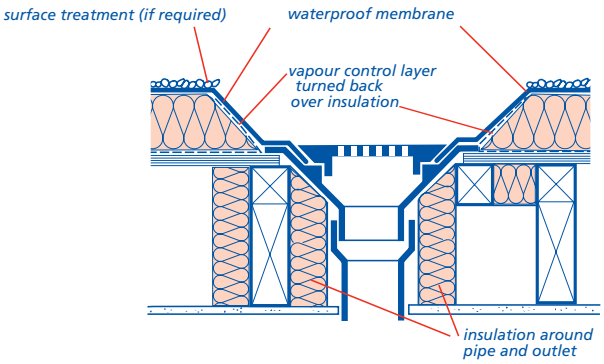
Upstand to ventilator or rooflight kerb
- similar details apply to cold and inverted roofs. The thickness of ballast in inverted roofs, to achieve upstand dimensions, should be allowed for.



Verge detail
- similar details apply to inverted deck



Pipe passing through roof
- vapour control layer should be bonded to waterproofing
- detailing of upstand and flashing is similar for all roofs



Rainwater outlet
- the opening should be properly trimmed
- the outlet should be at the lowest point in roof
- similar details apply to concrete roof
- ensure outlet is fixed securely to decking to prevent displacement by thermal expansion of rainwater pipe.

APPENDIX 7.1-D

Balcony access, weatherproofing and drainage

This Appendix contains guidance on the principles to adopt for the weatherproofing and drainage of balconies which may then have an accessible threshold. Depending on the design, specific fire, thermal and acoustic issues may also need to be taken into account.

The design and construction of accessible balcony thresholds should incorporate all of the following:

• a door threshold with an upstand of not more than 15mm
The 15mm threshold upstand is measured at the door position. Additional sloping transition elements, such as a small internal ramp and external sill, may be provided either side of the upstand. The maximum slope on ramps and sills should be 15 degrees.

• a door threshold with a minimum 45mm projecting sill and drip.
The sill should have a minimum 45mm overhang and drip to shed rainwater away from the interface between the waterproofing layer and the sill and to avoid reliance on exposed joint sealants and their limited design life.

• a balcony upstand of minimum 75mm below the underside of the threshold.
The balcony upstand is measured from the balcony drainage layer to the underside of the projecting sill. Note: the drainage layer may not be the waterproofing layer. For example, with an inverted roof the drainage layer would be the top of the insulation and not the waterproofing layer below. This is because drainage between the insulation and waterproofing layer could become silted resulting in the majority of rainwater flowing over the top of the insulation.

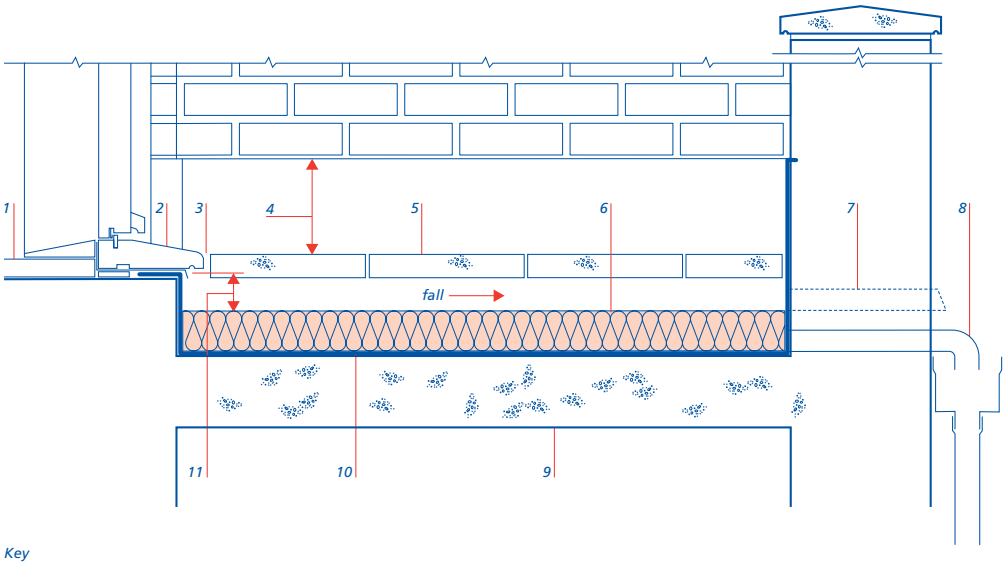
• a waterproofing layer designed to prevent ponding and associated stagnant water.
Finished falls should be a minimum 1:80 away from the building to the rainwater outlet(s). Where balconies are designed with falls toward or parallel to the building care must be taken to ensure any blockage of the outlet(s) cannot cause flooding into the building. Waterproofing layers at zero falls will only be accepted if the waterproofing membrane has a third party assessment specifically for that use. The membrane should also be fully protected from direct trafficking, for example by provision of paving slabs or decking, and be UV resistant unless fully protected from daylight.
The membrane should be capable of withstanding any point loads from supports to decking or paving.

• an effective drainage system and suitable overflow
The drainage arrangement should ensure that if an outlet or downpipe becomes blocked it will not lead to flooding into the building. This can be achieved by using one outlet and an overflow (not less than the capacity of the outlet) or two outlets connected to independent downpipes. Alternatively, the balcony kerb can be set a minimum 25mm below the level of the door threshold to allow safe spillage in the event of water build up. An outlet chute through perimeter construction into external hoppers can also act as the overflow if it is of an appropriate size to serve both the discharge and overflow capacities.

• drainage gaps between any decking or paving and at balcony perimeters
Drainage gaps between individual lengths of decking or between each paving slab should be a minimum of 10mm. A similar continuous drainage gap should be provided between decking or paving and the threshold sill, perimeter walls and kerbs. Spacers and supports to raised decking or paving should not obstruct the flow of rainwater to outlet(s). The position of drainage outlets beneath decking or paving should be clearly identifiable and accessible for maintenance.

• a minimum 150mm high splash zone above the decking or paving
The design of the wall for minimum 150mm above decking or paving should ensure that any splashing off the decking or paving does not reach any part of the wall that could be adversley affected by the presence of moisture. This may be achieved by the use of an impervious wall finish/cladding or an extension of the balcony waterproofing layer to form an upstand with cover flashings and cavity trays if required.

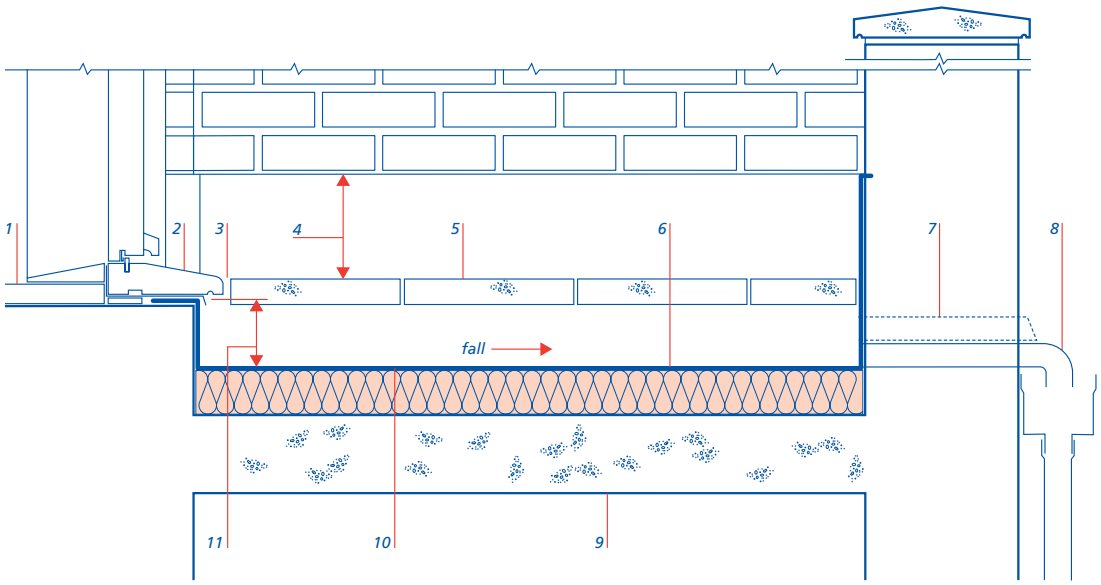
INVERTED BALCONY



Key

1 finished floor level
2 projecting sill and drip - minimum 45mm overhang
3 minimum 10mm gap
4 minimum 150mm splash zone (where applicable)
5 raised and drained decking or paving on drained supports
6 drainage layer is top of insulation
7 overflow/warning pipe outlet to be a minimum 25mm below the underside of the door sill
8 rainwater outlet and hopper - discharge should avoid passing through accommodation below
9 supporting slab
10 waterproofing layer with falls to outlet
11 minimum 75mm upstand

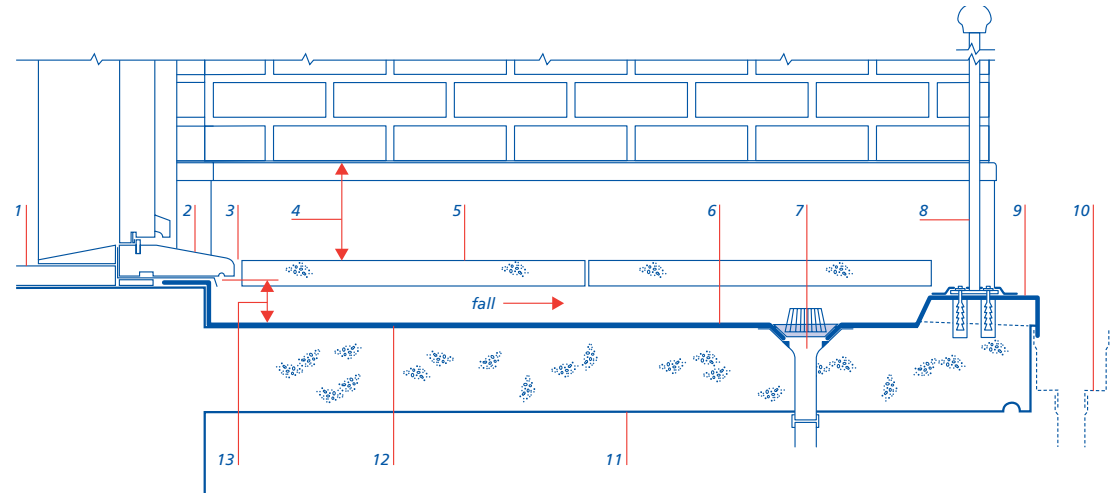
WARM DECK BALCONY



Key

1 *finished floor level*
2 *projecting sill and drip - minimum 45mm overhang*
3 *minimum 10mm gap*
4 *minimum 150mm splash zone (where applicable)*
5 *raised and drained decking or paving on drained supports*
6 *drainage layer is waterproofing layer*
7 *overflow/warning pipe outlet to be a minimum 25mm below the underside of the door sill*
8 *rainwater outlet and hopper - discharge should avoid passing through accommodation below*
9 *supporting slab*
10 *waterproofing layer with falls to outlet*
11 *minimum 75mm upstand*

CANTILEVERED BALCONY



Key

1 *finished floor level*
2 *projecting sill and drip - minimum 45mm overhang*
3 *minimum 10mm gap*
4 *minimum 150mm splash zone (where applicable)*
5 *raised and drained decking or paving on drained supports*
6 *drainage layer is waterproofing layer*
7 *rainwater outlet*
8 *balustrading*
9 *low kerb - minimum 25mm below the underside of the door sill to act as overflow*
10 *alternative hopper discharge*
11 *supporting slab*
12 *waterproofing layer with falls to outlet*
13 *minimum 75mm upstand*

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