BS6229: 2018 – A summary of changes

INTRODUCTION

BS6229 – Flat roofs with continuously supported roof coverings code of Practice) was last updated in 2003 and much has changed within the industry in that time.

The technical committee comprised of representatives from the NFRC, SPRA, LRWA, NHBC, BRE, BBA as well as other technical experts and consultants.

We expect a lot more from our flat roofs, be it slowing down the flow of rainwater, collecting solar energy, green spaces in urban areas or as part as a platform for rooftop structures.

The revised BS6229:2018 describes best practice in the design, construction, care and maintenance of roofs with flat or curved surfaces, at a pitch not greater than 10° to the horizontal, with continuously supported flexible waterproofing covering.

The supporting structure could be either dense or heavy (such as a concrete slab) or consist of framing members, which can support a lightweight metal or timber based deck.

Guidance on structural support, drainage, thermal performance, sound insulation, condensation control, fire precautions, watertightness, maintenance and repair is covered within the standard.

The 2018 standard is substantially shorter. The old version of the standard included fully supported metal roof coverings such as zinc and copper, whereas B26229:2018 does not deal with metal roof covering, which are now the responsibility of the British Standards Committee for Roofing and Cladding Products for Discontinuous laying.

Also, topics such as workmanship, condensation risk analysis, sound insulation and noise reduction are covered more fully in other British Standards, allowing this update to concentrate on the issues facing the waterproofing sector.

BS5250: 2011+A1: 2016. Code of practice for the control of condensation in buildings
BS8000-4: Workmanship on building sites - Code of practice for waterproofing
BS8233:2014 – Guidance on sound and noise reduction in buildings

TERMS AND DEFINITIONS:

Within the updated standard there are a number of updated or added definitions:

AVCL – vapour barriers and vapour control layers are now redefined as Air and Vapour Control layers as they are recognised to perform in the same manner.
WFRL – Water Flow Reducing Layer, recognised name for a permeable layer installed above the insulation in an inverted roof and some green roofs used to reduce the amount of water flowing to the waterproofing layer.
ZERO FALLS – clarity on the definition of zero fall, now defining that a zero fall is between 0° and 1:80°
BLUE ROOF - designed to attenuate the flow of water to the drainage system. This is used in SUDs (Sustainable Drainage Systems) to assist in meeting Building Regulations requirements and thus reducing impact on soakaways.

SECTIONS:

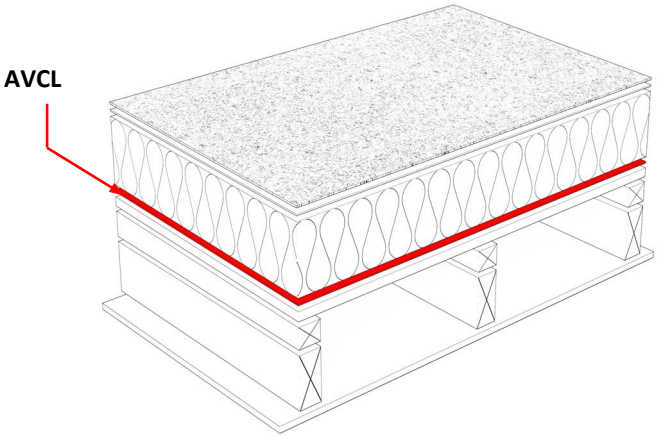
The 2018 version is split into 4 primary sections:
- Design
- Materials
- Workmanship
- Care and maintenance

The principle changes to the 2003 version are summarised within this guidance document. However This summary is not intended to replace BS 6229 or any other British Standard. If the designer requires clarification, they should always refer to the original Code of Practice and/or Standard, and manufacturer's recommendations.

DESIGN

Vapour Control Layers

Vapour Control Layer (VCL) are now defined as Air and Vapour Control Layers (AVCL), because if installed correctly to the manufactures instructions, they can control both air and vapour from entering the waterproofing system.



Air and Vapour Control Layer (AVCL) within a warm roof build up.

IKO Air and Vapour Control Layers -for Built Up Roofing Systems:

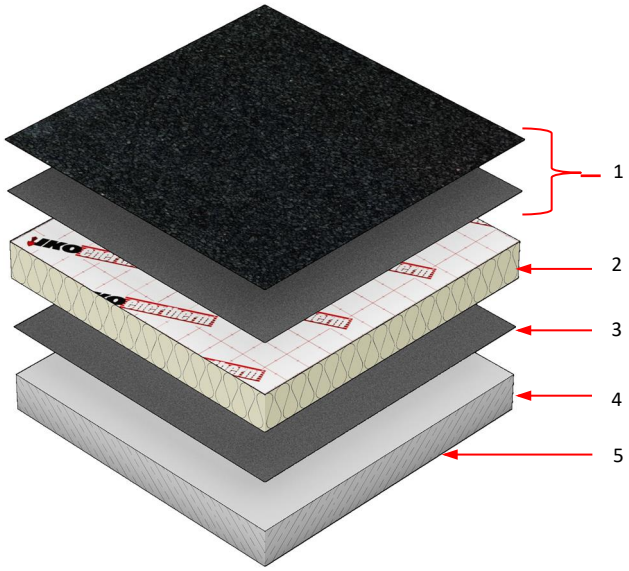
- **IKO Ultra S-A Vapour Control Layer**
  A high performance polyester reinforced SBS modified self-adhesive bitumen membrane Air and Vapour Control layer
- **IKO Ultra T-O Vapour Control Layer**
  A high performance polyester reinforced SBS modified Torch applied bitumen membrane Air and Vapour Control layer
- **IKO Easyseal Air and Vapour Control Layer**
  A high performance polyester reinforced SBS modified self-adhesive bitumen membrane Air and Vapour Control layer

Warm Roof

A warm roof is installed with the AVCL attached to the slab/deck on the warm side of the insulation, where it can control the air and moisture movement from within the building. If the AVCL is fully bonded to the slab/deck and sealed to all perimeters and penetrations, this can reduce the wind load on the waterproof covering if the slab/deck is air permeable.

The insulation must be structurally suitable for any intended loading of the roof, and tightly butted when installed to prevent thermal bridging; an interlocking rebated joint insulation scheme is the most secure way of achieving this. If the insulation is to be mechanically fastened, using thermally broken tubular washers will help reduce thermal bridging.

Warm roof build up



Key

1. Waterproofing layer with optional surface protection
2. Rigid thermal insulation
3. Air and Vapour Control Layer (AVCL)
4. Structural slab/deck
5. Internal finish

Inverted roof

An inverted roof has the insulation placed above the waterproofing layer. This type of flat roof is widely used for roofs that are subject to heavy traffic such as roof gardens, patios and car parks.

The insulation should have high resistance to water absorption and be strong enough to be able to support the loads that will be imposed on it. Insulation used in inverted roofs should always have rebated or interlocking joints to minimise the risk of thermal bridging.

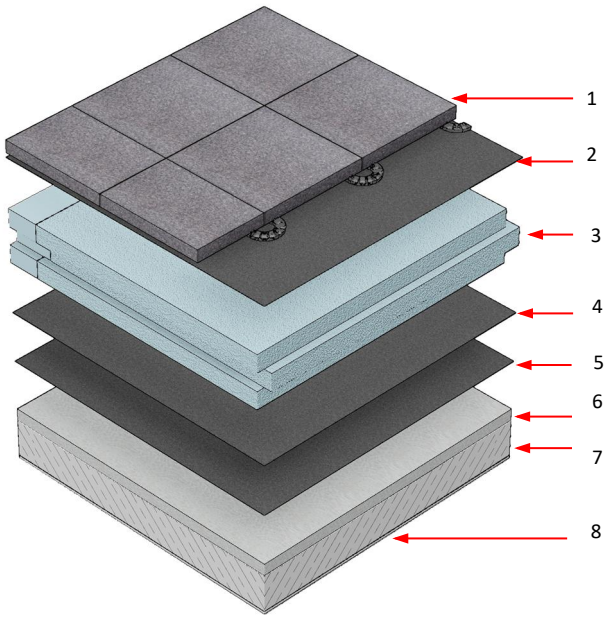
To regulate the movement of water and to protect against dirt and grit penetrating the joints of the insulation boards, a water flow reducing layer (WFRL) should be placed on top of the insulation. The WFRL can be easily damaged or displaced during the installation, so it is essential to take great care on site to ensure the long term effectiveness of the WFRL.

Because of the difficulty ensuring the long term effectiveness and integrity of the WFRL on site where it can get damaged, the thermal insulation in inverted roofs is regularly saturated.

Therefore, the roof system might remain permanently damp and not achieve the expected thermal

performance unless an allowance is made to the insulation thickness.

Inverted roof build up



Key

1. Ballast or slabs on supports
2. Water Flow Reducing Layer (WFRL)
3. Rigid thermal insulation
4. Drainage layer (optional)
5. Waterproof layer
6. Screed to falls
7. Structural slab/deck
8. Internal finish

Cold Roof

This type of roof build up has been traditionally used in the domestic market where homes are extended. The roof structure tends to be timber joists and a plywood deck which is then waterproofed.

However, there is a high risk of harmful interstitial and surface condensation forming on the underside of the deck and dripping onto the upper surface of the insulation. This is because the waterproofing layer, (which is situated on the cold side of the insulation and traditionally sits between the timber joists), acts as the AVCL.

Therefore, this type of roof is no longer recommended because of the difficulty of forming and maintaining an effective AVCL below the insulation and providing sufficient cross ventilation above the insulation.

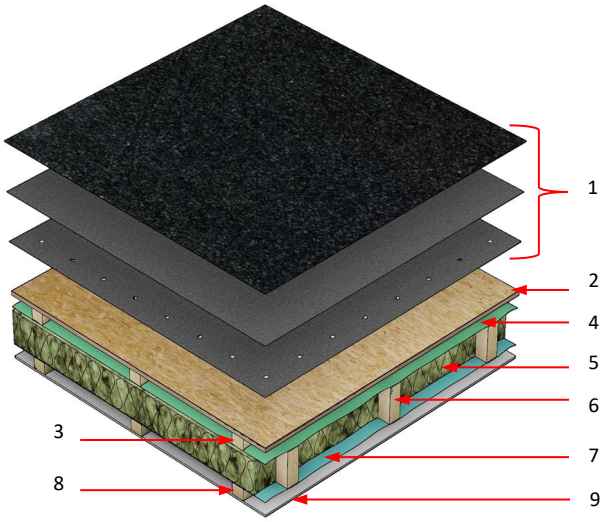
If this type of roof build up cannot be avoided, the cross ventilation opening width should not exceed 5 meters apart. Mushroom vents have proven to be ineffective in providing sufficient ventilation to prevent surface and interstitial condensation.

A minimum 50mm continuos vented void above the breather membrane must be provided.

A fully waterproof breather membrane should also be installed in all cold rof build ups on the cold side of the thermal insulation, taped and sealed to manufactures instrcutions. The breather membrane should be vapour permeable, rather than air permeable, and should allow water vapour to pass through it while providng a barrier to air, thereby minimising energy losses.

The new standard also provides recommendations of a 25mm service void below the AVCL.

Cold roof build up

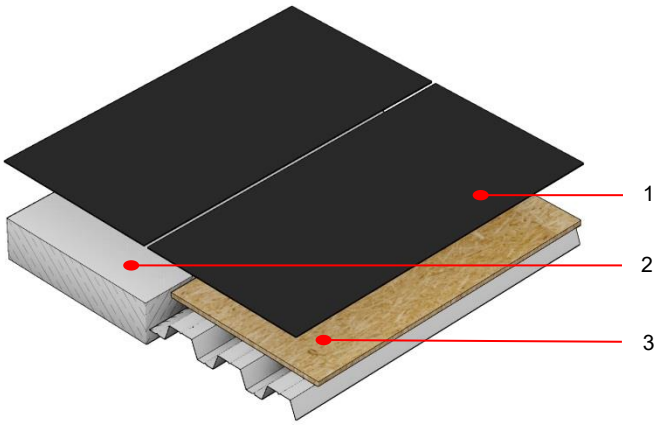


Key

1. Waterproofing layer with optional surface protection
2. Supporting structure/deck
3. Firrings to provide vented void (min 50mm deep)
4. Breather membrane
5. Thermal insulation
6. Structural frame
7. Air and Vapour Control Layer (AVCL)
8. Firrings to provide service void (min 25mm deep)
9. Internal finish

Uninsulated roof

In an uninsulated roof system the waterproofing layer is placed directly onto the slab/deck



Key

1. Waterproofing layer with optional surface protection
2. Concrete slab
3. Deck of plywood or similar on trapezoidal metal

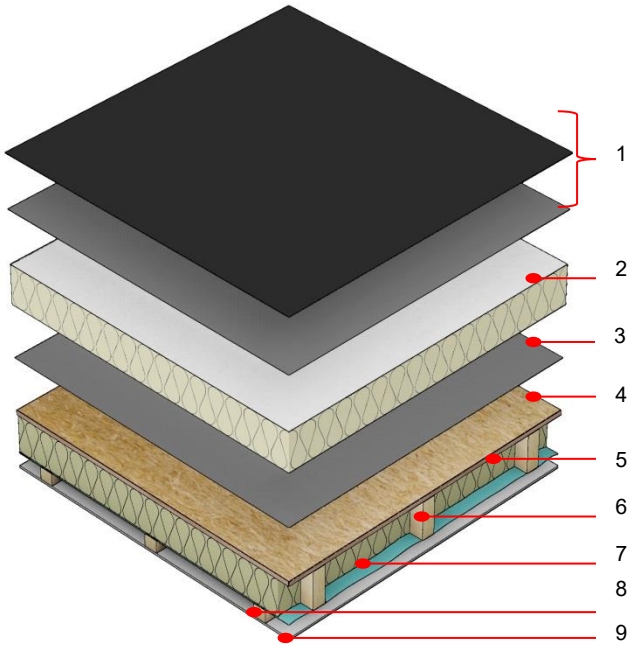
Hybrid roof

Hybrid forms of roof construction might combine various features of the three basic insulated systems, for example, when any existing cold roof is refurbished to a warm roof or where a structural panel with high thermal insulating properties is used.

In the case of upgrading an existing cold roof to a warm roof, where it is not possible to remove the insulation that sits beneath the deck, closing the air flow openings between the joists will form an air seal. This raises the temperature of the air void below the VCL and the insulation above, so that they work to their full potential. As there is an increased risk of interstitial condensation with a hybrid roof, it is recommended that a condensation risk analysis is carried out.

Some designers may specify hybrid flat roof constructions, with thermal and/or acoustic insulation placed on both the warm side and on the cold side of the deck.

Note: There is an increased risk of interstitial condensation with a hybrid roof and therefore it is recommended that a full condensation risk analysis is carried out.



Key:

1. Waterproofing layer with optional surface protection
2. Rigid thermal Insulation
3. Air and Vapour Control Layer (AVCL)
4. Structural slab/deck
5. Thermal insulation to fill void/soffit.
6. Structural frame
7. Air and vapour control layer
8. Firrings to provide service void (25mm min deep)
9. Internal finish.

Roof structure and loading

The roof structure should be designed for the strength of the specified waterproofing, and take into account any added surfacing including green roofs, paving slabs, gravel, blue roofs for rainwater retention, or any mechanical or electrical equipment which may be situated on the finished roof.

Roof falls for drainage

The reference to design falls in the new Code is much clearer stating that "**all flat roof surfaces including any formed internal gutters** should be designed with a fall of 1:40 to ensure finished drainage falls of 1:80 are achieved.

"This should take account of construction tolerances, permitted deviations and deflection under load, and account for deflections/settlement."

In other words, design should allow for all factors that could reduce or hinder the drainage eliminating the risk of ponding on roofs.

Ponding water adds a dead load to the roof structure and in exposed warm roofs increased stresses in the waterproofing layer

Zero falls

Certain third-party certified waterproofing and insulating systems are approved for use with zero falls.

The standard, for the first time, defines a 'zero fall roof' as a roof with a slope, which lies between 0° and 1:80. This means that back falls and ponding are not acceptable, and in order to ensure a finished surface with a zero fall, a design of 1:80 should be used and a detailed structural analysis should account for construction tolerances, settlement and deflection under load. If there are negative falls, then remedial action should be taken e.g. localised screed or additional of rainwater outlets at the lowest point.

To prevent ponding caused by waterproofing system lap, build ups around rainwater outlets, rainwater outlets should be recessed into the slab/deck or fitted in sumps when it is practicable to do so.

As a result, the roofing contractor should expect a flat, properly drained surface on which to lay the specified system and the finished roof should not suffer from ponding or inadequate drainage.

It is no longer acceptable for a main contractor to provide roof decks with large depressions, back falls and non-draining areas.

Rainwater disposal

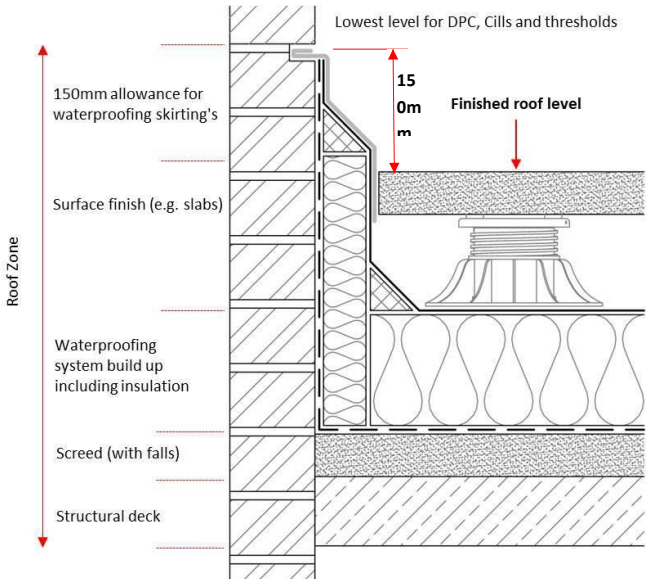
BS6229: 2018 considers it good practice for flat roofs to be deisgned to drain surface water from the roof as quickly as possible.

It is a requirement of the Building Regualtions Approved Document part H that adequate provison is made for rainwater to be carried from the roof.

However, some roof finishes are designed to control the disposal of rainwater from the roof. For example, green roofs are designed to support planting, and blue roofs are designed to attenuate the drainage of rainwater. These roofs may require additional rainwater design considerations. All blue roofs and roofs that drain into a single internal rainwater outlet or combined outlets connected to a single downpipe, should also be fitted with a visible overfow to drain and alert the building user of any blockages to the rainwater outlet.

Door threshold and upstand details

The minimum height of all upstands and abutments from the finished waterproofing system remains at 150mm and in the case of inverted, paved, green and blue roof that means from the surface finish.



In the case of protected roof systems, where paving slabs or other roof finishes have been installed, the 150mm measurement must be taken from the top of the protective finishes

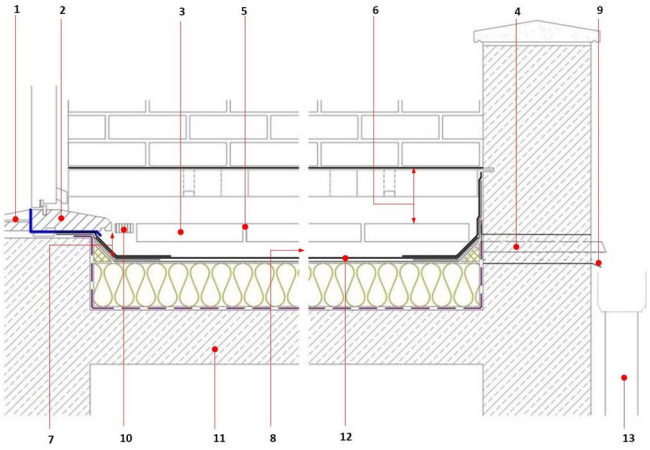
However, if level access is required from within the

building, as in the case of a door opening onto a balcony or terrace:

- The height of the clear upturn under the door threshold may be reduced to not less than 75mm (see Figures 4-6)
- The waterproofing should be fitted before fixing the door threshold It is important that the roof is designed with the rainwater falling away from the door, and in cases where there is an internal outlet or through-wall outlet:
- An overflow must be fitted a minimum 25mm below the height of the door threshold to prevent water ingress into the dwelling in situations of blockages to the outlet
- The height of the upstand must return to 150mm above the finished roof level beyond the door reveals

Level thresholds for access

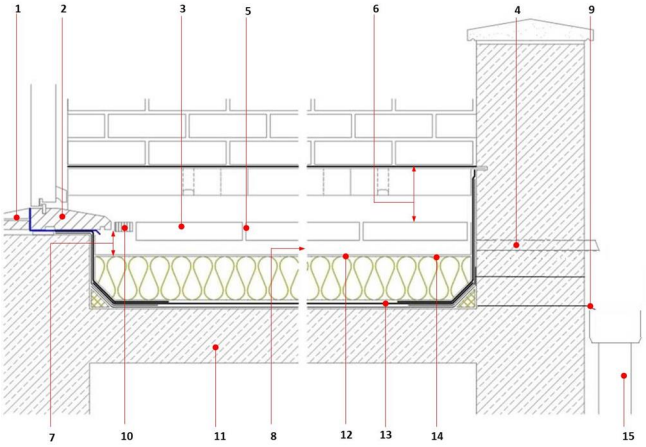
Warm roof balcony - *Figure 4*



Key:

1. Finished floor level
2. Projecting sill and drip (min 45mm overhang)
3. Raised and drained decking or paving on drained supports.
4. Overflow/warning pipe outlet min 25mm below the underside of the door sill.
5. Min 10mm gap between decking/paving and perimeter upstands/thresholds 5-8mm gap between decking and paving units.
6. Min 150mm splash zone
7. 75mm minimum upstand
8. Fall
9. Main outlet
10. Anti-splash grille (optional)
11. Supporting structure
12. Drainage layer is the waterproofing layer
13. Rainwater outlet (hopper should not pass through accommodation below)

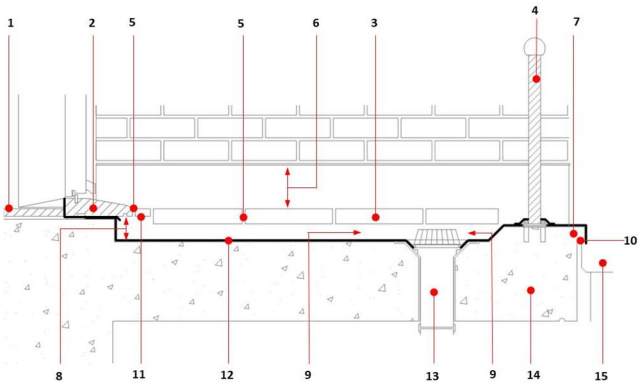
Inverted roof balcony - *Figure 5*



Key:

1. Finished floor level
2. Projecting sill and drip (min 45mm overhang)
3. Raised and drained decking or paving on drained supports.
4. Overflow/warning pipe outlet min 25mm below the underside of the door sill.
5. Min 10mm gap between decking/paving and perimeter upstands/thresholds 5-8mm gap between decking and paving units.
6. Min 150mm splash zone
7. 75mm minimum upstand
8. Fall
9. Main outlet
10. Anti-splash grille (optional)
11. Supporting structure
12. WFRL (Water Flow Reducing Layer)
13. Waterproofing layer
14. Drainage layer is the top of the insulation layer if WFRL is installed
15. Rainwater outlet (hopper should not pass through accommodation below)

Cold roof balcony - *Figure 6*



Key:

1. Finished floor level
2. Projecting sill and drip (min 45mm overhang)
3. Raised and drained decking or paving on drained supports.
4. Balustrading
5. Min 10mm gap between decking/paving and perimeter upstands/thresholds 5-8mm gap between decking and paving units.
6. Min 150mm splash zone
7. Low kerb min 25mm below underside of the door sill to act as an overflow
8. 75mm minimum upstand
9. Fall
10. Alternative outlet to hopper
11. Anti-splash grille (optional)
12. Waterproofing/drainage layer with falls to outlet.
13. Rainwater outlet
14. Supporting structure
15. Alternative hopper discharge

Thermal performance

The standard includes current advice in accordance with Building Regulations to avoid energy loss through cold bridging and air leakage. Reference is made to SAP2012, whereas this has been revised and published to SAP 10. At the moment SAP10 cannot be used in any publications until it is included in the Building Regulations.

The thermal performance of the roof is hugely affected by any gaps between the insulation boards, so it is crucial that the insulation is installed tightly-butted together. The installer should take great care to ensure this is maintained throughout the installation of the insulation system.

To prevent surface condensation within heated buildings, the minimum thermal performance (U-Value) permitted anywhere on the roof, including internal gutters, must not exceed 0.35 W/m²K, this also covers tapered insulation design schemes.

Minimum insulation thicknesses:

- 60mm PIR Insulations
- 90mm Rigid Mineral wool

Inverted roofs

In an inverted roof system, the correct installation of a WFRL (certified by independent third-party testing) immediately above the insulation, should help to restrict the cooling effect of cold water flowing through the insulation joints and across the waterproofing layer and into the drains.

The concept and use of membrane over the insulation in inverted roof applications was in its infancy when the 2003 edition was issued. Manufacturers undertook tests using the method in appendix C ETAG 031-1 *Guidelines for European Technical approvals of inverted roof insulation kits*. As such it was able to demonstrate the inclusion of a WFRL helped reduce the flow of water, meaning they could reduce the overall thickness of insulation.

However, it is now clear that small tests cannot be replicated in true life application due to the imperfections in the WFRL, resulting from poor detailing or workmanship at the roof perimeter and penetrations, and any post-construction damage, will result in a greater flow of water through to the waterproofing than is indicated when the roof construction is tested. Until further research and test evidence is made available, it is prudent to increase the design thickness of the thermal insulation by no less than 10%.

The statement within BS6229: 2018 regarding insulation used in inverted roof systems has caused some sectors of the industry to raise debate this issue in which some have stated there is no requirement for any increase in insulation. It must be noted and raised that suppliers should demonstrate and prove why such a correction factor should not be undertaken. This is highly critical where who takes on design liability and if insurance companies would insure against design not undertaken in accordance with BS6229: 2018. We are sure the debate will go on, but until such time it has been proven and can demonstrate with a detailed assessment to the effect of a WFRL installation, then the guidance within BS6229 should take precedence.

Green roofs

The thermal performance of the landscaping elements of green roofs can only be included in the U-value calculation if this can be accredited by third-party certification.

Blue roofs

A blue roof is defined in BS 6229 as a “roof designed to attenuate the rate at which rainwater is drained from the roof and is allowed to enter the drainage system”. This is used in SUDS (Sustainable Drainage Systems) assisting the building to meet BREEAM and Building Regulations needs. It also helps to prevent damage to soakaways.

A blue roof is not water storage on a roof.

Unlike warm blue roofs, inverted blue roofs are vulnerable to increased heat loss due to rainwater cooling.

In an inverted blue roof system, the correct installation of a WFRL (certified by independent third-party testing) immediately above the inverted insulation, cannot be determined to restrict the cooling effect of cold water flowing through the insulation joints and across the waterproofing layer and into the drains.

The test method for determining water flow through an inverted roof with a WFRL does not allow for a head of water as is the case in a blue roof. The correction method commonly used for inverted roof thermal calculations when using a WFRL is not permitted and will result in increased inverted insulation thicknesses.

Warm blue roof designs will not be affected by this issue.

When designing a blue roof, it might be necessary to increase the weight of the protection to avoid flotation of the insulation and care should be taken to ensure the roof structure can withstand this extra load.

Control of condensation

BS 6229:2003 included a large section on this; however BS 5250: 2011+A1: 2016 Code of Practice for control of condensation in buildings is the senior document and is currently being revised.

The requirement remains though that, in assessing the risk of interstitial condensation, designers should still use an external temperature of -5°C for 60 days during the heating season to allow for the cooling effect of clear sky radiation.

Care should be taken to ensure that the correct humidity class is selected for the building, particularly for high humidity buildings such as swimming pools and sports halls and also areas of the building such as kitchens and bathrooms. The risks should be reassessed if there is a change of use.

The risk of condensation within the roof is greatly increased by air leakage which can transport water vapour; to prevent this, the AVCL must be sealed at all laps, penetrations and abutments.

Condensation – Surface

To ensure there is no risk of surface condensation, legislative guidance requires the roof of a heated building to be insulated to a U-value of 0.35W/m²K or better; BS 6229:2018 concurs with this.

Surface condensation is removed where continuity of the roof insulation occurs at upstands and penetrations.

The standard looks to remove the practice of thin insulation within gutters and low points within tapered insulation schemes.

Approximate minimum insulation thicknesses to achieve 0.35W/m²K are:

- 60mm for PIR
- 100mm for mineral wool

Sound attenuation

A fat roof might be required to provide soundproofing when, for example, the building contains noisy activities, or is sited near a source of noise, such as a road, railway or airport. Soundproofing may also be required to reduce the sound of rain falling onto the roof.

By incorporating sound absorbing and deadening materials, such as mineral wool insulation, noise levels can be reduced significantly.

Fire safety

The level of free resistance of a roof required by Building Regulations depends upon the purpose of the building. The main factors that should be considered are:

- The amount of combustible material in the building
- The type of occupancy
- The height of the roof above ground

Any part of the fat roof forming part of an escape route should provide free resistance of 30 minutes when tested from the underside, with the route clearly defined by guard rails or barriers.

Flues passing through a fat roof should be insulated and isolated from any combustible roof structure or waterproofing to prevent any softening of the waterproofing.

Safe2Torch principles need to be implemented at the design stage of a waterproofing system, and strictly adhered to throughout the planning and construction

phase in order to prevent fires during the installation of the waterproofing system.

Surface protection

The life of a waterproofing covering is increased by protecting the surface against UV light, excessive traffic and variations in temperature. Waterproof membranes are generally manufactured with surface protection such as UV coatings or mineral granules; site-applied surface protection can include reflective paint, bonded chippings or stone ballast.

Where foot traffic is anticipated across a flat roof (such as maintenance of roof mounted equipment), a designated route should be defined by providing a proprietary walkway system that offers protection to the waterproofing covering and does not create a water check.

The combined effects of wind uplift and flotation means the insulation and roof covering needs to be secured (ballasted) on an inverted roof system. This ballast may need to increase further with an inverted blue roof design, and care should be taken to ensure that the roof structure can withstand this extra loading, in addition to the attenuated rainwater.

Where the insulation is secured by ballast, the aggregate should be of a sufficient size to prevent displacement by the wind.

Intensive green roofs require appropriate root-resistant material above inverted insulation because no corrective value is available for the damage caused to the insulation by the roots over the life of the roof.

Rooftop components

Rooftop components and installations include roof lights, ventilation, smoke extraction, vents and access hatches.

These items will all influence the overall thermal and sound performance of the roof and could potentially affect the water integrity of the building.

Plant and equipment essential to the operation of the building, such as air conditioning units, water storage, solar panels and aerials may also be situated on the fat roof. The pipework and cables connecting such equipment to the interior of the building should therefore be designed so as not to affect the integrity of the roof covering.

Smaller lightweight items might be located on feet that spread the weight across an area of the roof system; these feet should be fit-for-purpose and compatible with the waterproof covering.

Larger, heavier items should be set on a kerb or plinth not less than 150mm higher than the finished roof surface.

WORKMANSHIP

Before undertaking any flat roof work the contractor should be in possession of the complete specification detailing how the work is to be carried out, the materials to be used and any components to be incorporated.

Flat roofs can fail due to rainwater or moisture being trapped within the waterproofing system during the construction phase. It is therefore essential that great care is taken to avoid this happening, and the contractor should make suitable arrangements when planning the construction.

It is important to keep all roofing materials, especially insulation and timber products, dry at all times to protect the roofing work in progress, avoiding the use of any materials that have become wet.

As each layer of the waterproofing system is completed it should be examined and, if necessary tested. This is particularly important, when checking the AVCL, to ensure the membrane is sealed at all laps, penetrations and at junctions between the roof and walls.

All completed work should be carefully examined and if necessary, tested before being handed over to client or principal contractor.

MAINTENANCE REQUIREMENTS AND PROCEDURES

The new Code has a complete section on the actions needed to maximise the reliable service life of a flat roof.

A Roof or building maintenance manual should be provided, including information on the design, specification and construction of the roof, as-built

drawings, specification (as installed), testing certificates, parties involved, warranties, frequency of inspections and procedures for maintenance

A flat roof should be inspected at least twice a year in the spring and autumn.

Leaves, dirt and debris should be cleared away. Rainwater outlets should be checked to ensure they are free draining.

Specialist roofs, such as blue and green roofs, should have their own inspection plan that should be adhered to.

Additional inspections will be required in the event of extreme weather conditions or construction work being carried out on or near to the waterproofing.

Safety equipment such as fixed ladders and edge protection, fall arrest posts and harness points must be tested in line with the manufacturer's instructions to ensure they are safe to use. The integrity of waterproofing around these items will also need to be checked.

Repair

If during inspection it is discovered that there is a need for a repair or replacement of any part of the waterproofing, the work should be planned to be undertaken as soon as possible following the Safe2Torch principles. Any repair should be completed using materials and techniques compatible with the original waterproofing system and, if still under the original guarantee, by the original installer.

It is important to make a note of any inspection or repair within the building's maintenance manual.

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