GUIDANCE NOTE No. 15

Clarification of BS6229:2018 regarding the thermal performance of inverted roofs and inverted blue roofs

1. Introduction

This guidance note has been produced by a Specialist Technical Group (STG) convened by the LRWA Technical Committee. The STG consisted of technical experts from the waterproofing, insulation and blue roofing industry.

2. What is BS 6229:2018?

BS 6229:2018 is the British Standard code of practice for flat roofs with continuously supported flexible waterproof coverings. It sets out guidance and recommendations regarding what is considered to be current best practice in the design, construction and maintenance of "roofs with a flat or curved surface, at a pitch not greater than 10 degrees to the horizontal".

The standard has no legal or regulatory standing, its contents are strictly guidance and recommendations. The foreword is clear that none of the document's contents should be quoted as if a specification.

3. Explanation of Inverted Roofs and the Effect of Moisture on Thermal Performance

An Inverted Roof is one where the primary waterproofing is installed directly onto the structural deck with the thermal insulation placed above the waterproofing membrane and finished with paving, ballast, hard landscaping, a green roof and/or a blue roof. Installing thermal insulation over the waterproofing places specific demands on the design and performance of the roof and its insulation.

Effect of moisture on thermal performance in inverted roofs:

1. **Reduction in thermal performance of the insulation material due to moisture absorption.**
   Moisture absorption by insulation materials, is addressed through the use of a moisture correction factor. It is applied to the declared thermal conductivity (λ_D) of the insulation and produces the design thermal conductivity (λ_U) figure that must be used in the calculation for thermal transmittance (U value). Always refer to the manufacturer's datasheet for further information.

2. **Cooling effect of rainwater reaching the waterproofed roof deck.**
   The rainwater cooling effect is dependent on the volume of rainwater that reaches the waterproofed deck and must be accounted for in U-value calculations. To restrict how much water can pass through the system, a membrane called a water flow reducing layer (WFRL) is loose laid over the thermal insulation prior to installation of the chosen surface finish. The correct installation and performance of a WFRL is covered in LRWA Guidance Note No.14.

4. BS 6229:2018 Stance on Thermal Performance of Inverted Roofs

The thermal performance of all insulated roof systems, warm or inverted, relies on the effectiveness of the thermal insulation. Where inverted roofs are designed and installed to achieve zero falls, the roof should be constructed so as to avoid backfalls or ponding and promote free drainage. More detail is available in LRWA Guidance Notes No.7 and No.14.

BS 6229:2018 identifies construction quality - and the installation of the WFRL in particular - as a reason for inverted roofs potentially under-performing and achieving a worse-than-expected in-service thermal performance. However, if manufacturers' installation instructions are followed, and site management restricts access to the roof until such time as finishes are applied, the WFRL will perform as intended and deliver the expected in-service thermal performance.

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The standard attempts to mitigate against higher volumes of water reaching the roof deck than were designed for by proposing a 10% increase in the insulation thickness (compared to the thickness established by the uncorrected U-value calculation, i.e. prior to calculating the rainfall cooling effect and consequent U-value correction).

5. Clarification on the Purpose of Notes Within British Standards

The suggestion of a 10% increase in insulation thickness is contained within a note to the text of the standard, and as such is not part of the formal recommendations. The foreword of BS 6229:2018 is clear that: “Notes give references and additional information that are important but do not form part of the recommendations.”

The note has caused confusion within the construction industry, because many specifiers view it as compulsory and are unaware of its status in the standard.

In the main text, BS 6229:2018 is clear that U-value calculations should continue to be carried out in accordance with the combined method detailed in BS EN ISO 6946:2017. The method includes a correction to be applied for rainwater cooling in inverted roofs.

Insulation systems, including a WFRL, are tested according to the method in ETAG 031 Guideline for European Technical Approval of Inverted Roof Insulation Kits, to establish the percentage of rainfall that is able to enter into the system. This value (known as ‘f’), as well as the local average rainfall for the building location (‘p’), is used to establish the correction.

The British Board of Agrement (BBA) have chosen not to implement the suggested 10% insulation thickness increase in their product certification for inverted roof systems featuring thermal insulation and a WFRL as doing so fails to take into account the significant variance in the rainwater cooling effect, which varies across the UK depending on project location. For the purposes of product certification, the BBA applies a minimum ‘f’ value of 2.5% to account for rainfall entering the system as rainfall volumes vary significantly across the UK, so does the magnitude of the U value correction and consequent increase in insulation thickness needed to compensate for it.

Within the note in BS6229:2018 there is a reference to ‘until further evidence and test data is made available’ because it has been acknowledged that both 10% (BS6229:2018) and 2.5% (BBA) are arbitrary and not based on scientific based data.

The LRWA STG is currently working with the BBA to develop testing that will assist the BBA approach of using an ‘f’ value adjustment, and what the adjustment percentage should be as the collective belief is that the value of ‘f’ should be the adjustment factor not an arbitrary insulation thickness increase of 10% as this does not achieve a consistent effect across all roofs, whereas adapting the rainwater cooling correction calculation in BS EN ISO 6946 takes into account the roof’s location and the amount of rainfall.

6. BS 6229:2018 Stance on Thermal Performance of Inverted Blue Roofs

Where a blue roof water attenuation system is proposed over an inverted roof construction, BS 6229:2018 says the thermal insulation in inverted blue roofs is “regularly saturated”. The LRWA STG challenges this statement as not based on any proven testing and not representative of the way that blue roofs perform. The weight of evidence is that blue roofs perform in ‘attenuating mode’ only a few times per year, and that day to day blue roofs drain like ordinary inverted roofs

As noted above, volume of water is not a factor in the performance of the insulation itself. Moisture correction factors to give design thermal conductivity values for insulation materials are based on tests for long term water absorption. Regularity of saturation is not an issue.

Existing guidance on blue roofs is not fully developed. At the time of writing, the Construction Industry Research and Information Association (CIRIA) is undertaking a process to develop more comprehensive guidance, but this will take time.

BS 6229:2018 says that when calculating the thermal performance of a blue roof, the value of ‘f’ should be that for an ‘open system’ (ie one without a WFRL) - either 0.75, or 1.0 if square-edged insulation boards are specified rather than boards with profiled edges. In reality, in almost all circumstances (and as noted in LRWA Guidance Note No.14), the specific combination of insulation and WFRL should be

installed together in an inverted, blue roof design. As such the presence of the correct WFRL negates the statement above.

7. How is the Flat Roof Industry is Responding?

The LRWA and BBA are working together to develop a new scientifically based test method to determine a realistic 'f' factor and develop an industry standard for WFRL installation.

The BBA have proposed an "enhanced" test based on the method in ETAG 031 which includes more typical (true to life) roof features. Such features are considered likely locations for rainwater penetrating the insulated system. The test proposal has also been designed to potentially examine the effect of water flow attenuation in a blue roof design.

While this testing is carried out and the results analysed, the decision on whether, and how, to address the thermal performance issues raised in this document should be made by the specifier.

A 10% increase in insulation thickness on an inverted roof is not mandatory. Thermal insulation manufacturers should be able to explain the values used in any U-value calculations they produce, as well as offering guidance on WFRL installation.

Where an inverted roof is designed to act as a blue roof as well, consultation with both the insulation manufacturer and the blue roof system supplier is recommended to ensure all parties understand the build-up of the system.