

1. Introduction

The purpose of this Note is to clarify the LRWA policy on flat roof falls. It considers constructions where the waterproofing is exposed, used in an inverted roof system or other buried systems.

Flat roofs are often subjected to standing water, or ponding, especially during or following heavy rain. Many modern high-performance liquid applied waterproofing membranes are more than capable of accommodating ponding without detriment to the integrity of the waterproofing system. Certain liquid systems are specifically designed for permanently submerged applications including water features, fountains etc and so have no issues with ponding water.

However, it is the opinion of LRWA that zero falls are not acceptable in an exposed roof situation and that ponding water should ideally be avoided because;

- there is a greater potential for water penetration and subsequent damage if the roof should be punctured by mechanical damage in a ponded area
- it may cause progressive deflection of the deck due to increased loading. As this happens the depth of ponding water will increase thus increasing the load on the structure, causing further deflection. A 1m² area of ponding water, 1mm deep on a roof has a mass of 1kg/m². Hence a depth of 25mm of ponding water over an area of 20m² would add a dead load of 500kg, which the roof structure may not be able to accommodate
- water on exposed roofs will increase the risk of slip hazard where no provision for safe walkways has been provided. In cold weather this will be compounded by an increased risk of ice, which will substantially increase the health and safety issue
- it can lead to the build-up of dirt, leaves and algae. This can be unsightly, unhygienic become a slip hazard and may obstruct outlets increasing the potential for further ponding
- in inverted roofs, the thermal performance of the roof may be adversely affected

2. Existing Roofs

Over time, existing roofs, initially designed with a fall, can deflect creating the opportunity for rainwater to pond. This is often, but not exclusively, associated with lightweight roof constructions. The causes of this occurrence can include deflection of the structural members, imposed / dead loads and typical construction tolerances. It should be noted that re-waterproofing an existing roof alone will not address a pre-existing ponding issue. However, unlike some sheet systems, the seamless finish that a correctly applied liquid system provides should not increase the risk of standing water or ponding. The negative effects of inadequate falls outlined in the introduction should be considered when re-waterproofing an existing roof.

If ponding occurs and does not dissipate in a reasonable period of time, then consideration should be given to improve the falls and/or drainage. This can usually be achieved with a tapered insulation system for warm roof overlays and/or additional outlets, installed as part of the refurbishment works. Where an existing flat roof is to be thermally upgraded in accordance with building regulations or within a Green Deal package, then tapered insulation would be the preferred solution as improvements in both the drainage and thermal performance of the roof can be achieved. Tapered insulation systems for remedial projects are designed to drain water from flat roof areas as efficiently as possible, however, 100% drainage efficiency may not be achieved, due to building and construction tolerances and other constraints. Consequently, there may still be limited amounts of standing water after rainfall. Any advice provided should always be subject to a comprehensive site investigation report.

3. New Exposed Roof Waterproofing

The design of falls is covered by BS 6229:2018 *Flat roofs with continuously supported coverings. Code of practice*, BS 8217:2005 *Reinforced bitumen membranes for roofing. Code of practice* and NHBC Standards. New flat exposed roofs should be designed to have adequate finished falls and to drain efficiently. Typically this can be achieved either in the deck or by using tapered insulation.

BS 6229 defines a flat roof as “having a pitch not greater than 10° to the horizontal” and states that the minimum finished falls at any point on a liquid waterproofing system should be 1:80. It is usual to design roofs with a fall greater than 1:80 to allow for deflection of the structure or for site inaccuracies. Falls of 1:60 or 1:40 are commonly designed with the expectation of achieving a finished fall of 1:80 on the completed roof and reducing the potential impact of future deflection.

4. Exposed Balcony and Walkway Areas

Balconies and walkways are designed for access and as such are more at risk of causing slip hazards under standing water conditions as detailed above. Ice is a particular risk for trafficked areas. For small and certain other low risk areas it may be possible to design to falls less than 1:80 provided that the area is completely free draining and that there are no back-falls or hollows. The designer or client should be made aware of the risks if the area is not freely draining.

Furthermore, it should be noted that where flush access is required at door thresholds attention should be given to allow adequate detailing. Please refer to BS6229:2018 *section 4.5 Rainwater Disposal* for guidance on level access.

5. Inverted Roofs

Where an inverted roof solution is certified by a third party as suitable for use on a ‘zero falls’ roof, the guidance in BS 6229 is clear that a design fall of 1:80 should be used as back falls are not acceptable.

Detailed structural analysis should be used to prove the roof deck as designed will not suffer from negative falls when works are complete. Negative falls are likely to result in ponding water which could form a reservoir that increases the amount of water that could drain into the building through any mechanical damage.

Following the publication of ETAG 031 Guideline for European Technical Approval of Inverted Roof Insulation Kits, there has been much activity and debate within the flat roofing industry on the subject of falls for inverted roofs. British Board of Agrément Information Bulletin No 4 *Inverted roofs – Drainage and U value corrections*¹ also provides guidance on providing adequate drainage.

This debate primarily focuses on whether the thermal performance of inverted roofs can be accurately calculated where there is extensive ponding on the roof. Any rainwater that reaches the waterproofing membrane will have a cooling effect on the roof deck below and so reduce the thermal performance of the roof. This cooling effect has to be considered when calculating the U-value. It is dependant on a number of factors including the local average rainfall for the building location and the quantity of water that permeates through the inverted roof insulation and ballast. The method of calculating the U-value is given in Annex D of BS EN ISO 6946: 2007 and takes account of this cooling. For further information refer to LRWA Guidance Note 15: *Clarification of BS6229:2018 regarding the thermal performance of inverted roofs and inverted blue roofs*.

The inclusion and correct installation of a water flow reducing layer (WFRL) above the inverted roof insulation reduces the volume of rainwater reaching the primary waterproofing layer, mitigating the impact of this cooling effect. U-Value calculations must be adjusted to reflect the effect of the WFRL. For WFRL's to be effective they too must not retain ponding water on their surface. For further information refer to LRWA Guidance Note 14: *Best Practice for the Installation of Water Flow Reducing Layers in Inverted Roofs*

Ponding water will have a detrimental effect on the achieved thermal performance of inverted roofs. However, as the quantity of ponding water on a roof is usually unknown it cannot be taken into consideration when calculating the U-value. Therefore, every effort should be made within the design of

¹ [www.bbacerts.co.uk/pdf/BBA Information Bulletin No 4i1.pdf](http://www.bbacerts.co.uk/pdf/BBA%20Information%20Bulletin%20No%204i1.pdf)

the roof build up to prevent ponding water. Inverted roof decks should, therefore, be constructed to the designed falls without back-falls and hollows and be free draining.

6. Other Buried Applications

In plaza or podium decks, where there are falls and drainage within the surfacing, falls at the deck and waterproofing level may be less important. In these cases it may be acceptable to design the structural deck to zero falls as drainage will occur above the waterproofing. The requirement for falls in the surfacing will be determined by the use of the area involved.

Excess water accumulation in a Green Roof system can have an adverse effect on the imposed dead load and planting. In extreme conditions it could change the whole green roof ecosystem.

For all waterproofing applications and especially inverted and buried roof systems it is advisable where possible to use a suitable waterproofing integrity test on completion of the waterproofing and before the rest of the build-up is installed.

7. Drainage Design

The design of roof drainage systems should be in accordance with BS EN 12056-3:2000. This will specify the number and size of outlets as well as their location. For inverted roofs it is necessary to provide drainage at two levels, namely the level of the waterproofing and above the insulation. This is of particular importance where water flow reducing layers are used to control the quantity of water that reaches the waterproofing below the insulation.

8. Conclusion

Exposed and inverted roofs present differing design criteria with regards to falls and it is hoped that the above guidance helps to expand the relevant issues affecting both types of roof construction.

In all cases it is essential to consider the following points;

- standing water should be avoided to avert the negative effects listed in Section 1
- the design of new exposed roofs or refurbished existing roofs should provide efficient removal of water to the designated drainage points
- that the drainage system design provides efficient drainage of water from the roof
- that the designed falls on the roof are achieved on the finished roof. Roofs designed to be “completely flat” or “zero falls” (falls of less than 1:80), such as inverted or protected roofs, must achieve this as a minimum, i.e. there must be no back-falls or hollows and the roof is free draining
- the relevant codes of practice or manufacturer’s documented advice are always referred to
- that the roof structure is designed for the potential of additional loading
- the detrimental effect on U-value calculations for inverted roofs where there is ponding water

LRWA was founded in 1979, and consists of the UK’s leading manufacturers of liquid roof coatings and related material suppliers. It aims to raise awareness about the technical and financial benefits of specifying liquid applied roofing systems and to establish both product and installation standard to ensure optimum performance is achieved; to this end LRWA has been involved in the writing of European Technical Approvals as the official body in conjunction with the BBA and EOTA.

Whilst every effort has been made to ensure the accuracy of the information contained in this publication, it must be emphasised that the Association has itself not verified the information by independent testing: for this reason and because the Association has no control over the precise circumstances in which it will be used the Association, its officers, employees and members can accept no liability arising out of its use, whether by members of the Association or otherwise. The publication is of a technical nature only and makes no attempt to state or conform to building regulations or other legal requirements; compliance with these must be the individual user’s own responsibility.