Liquid Roofing and Waterproofing Association

GUIDANCE NOTE No. 7
Specifier Guidance for Flat Roof Falls

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. The ability to accept standing or ponding water or use for permanently submerged areas should be specifically confirmed by the product manufacturer.

For standard flat roof applications, 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 1m^2 area of ponding water, 1mm deep on a roof has a mass of 1kg/m^2. Hence a depth of 25mm of ponding water over an area of 20m^2 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 6229:2003 *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 then in Table 6 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.

The above applies to the use of liquid waterproofing systems in an exposed waterproofing application. There is a note to Table 6 for liquid waterproofing systems as follows “For certain specialist systems designed solely for buried applications, such as garden roofs, podia, and some car parks, specific reference should be made to the manufacturer’s documented advice and British Board of Agrément certification”. The note to Table 6 is therefore not applicable to exposed waterproofing as it is not a buried application.

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.

5. Inverted Roofs

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.

The inclusion and correct installation of a water reducing layer 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 water reducing layer. For water reducing layers to be effective they too must not retain ponding water on their surface.

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 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.

[1] www.bbacerts.co.uk/pdf/BBA Information Bulletin No 4i1.pdf

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) must achieve this as a minimum, i.e. there must be no back-falls or hollows
- 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