NFRC

NFRC Technical Guidance Note for the construction and design of Blue Roofs.

Roofs and podiums with controlled temporary water attenuation.

Contents

Introduction

Fundamental to this guidance is the principal that a Blue Roof should not be considered as a water storage solution.

No British or European standard covers this type of application at the present time. A specially formed committee of the NFRC Joint Flat Roofing Technical Committee, whose members include, Membrane and System Manufacturers, Insulation Producers, Standards and Certification Bodies, Drainage Consultants and representatives from Flat Roofing trade associations, was tasked to produce the following technical guidance notes to support the design of technically correct Blue Roof construction and provide information for specifiers, designers and installers.

A Blue Roof is a Flat Roof, designed to allow controlled attenuation of rain fall during heavy and storm events as part of a Sustainable Urban Drainage Systems (SuDS) good practise policy, replicating the natural environment or improving the as built environment. A Blue Roof will treat and release the water at a managed and controlled rate directly into the sewers waterways and river systems.

A Blue Roof can be created at either roof or podium level above the waterproofing membrane in a warm roof application and above the water flow reducing layer (WFRL) in an inverted application, and should attenuate water for no more than a 24 hour period from the end of the maximum designed rainfall event. The discharge rate should be calculated to allow the roof to be half empty of attenuated water in a 12 hour period.

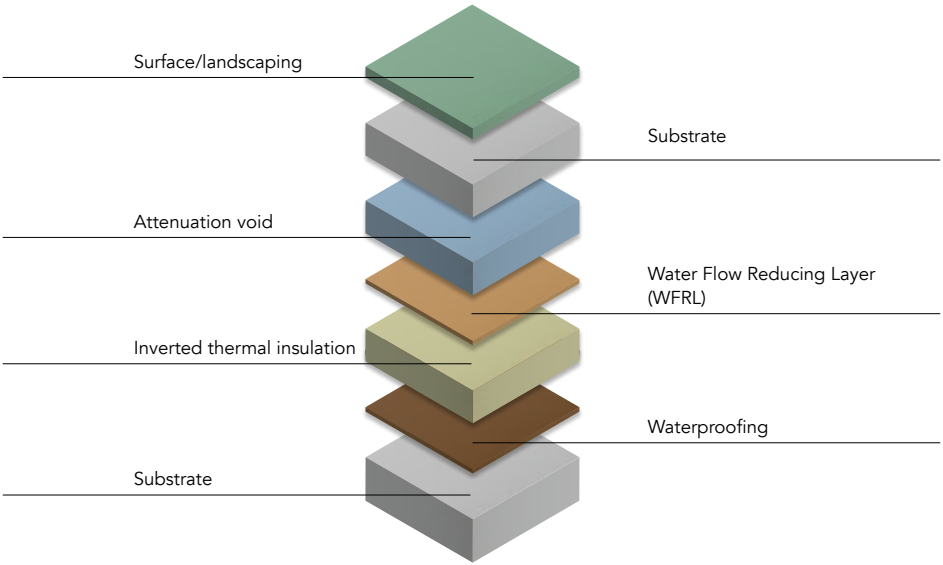
The blue roof is designed to attenuate this water within various elements which must provide a multidirectional free flowing path above the waterproofing membrane, for water to reach the drainage points on the roof surface.

These elements must provide a void to contain the designed attenuation capacity of storm water and must have a surface finish to meet the recommendations within this design guidance.

01 Drainage

The overall drainage discharge rate from many sites is now limited to greenfield run-off rates, which may be as low as 5 to 8 ltr per second per hectare of site, as part of the SuDS proposals. However sometimes planning authorities set minimum limits to design outflows, which may be higher than the greenfield rate for small sites, so it is important wherever possible to find out the total allowable discharge for the particular site being designed, which should have been agreed at planning stage. A calculation will then be required to work out the roof/podium percentage of the site area, to assign the correct discharge rate to that area. It may be acceptable to apportion a higher or lower percentage of the controlled discharge to the roof/podium area but this may be limited by available height or loading restrictions, and the availability of storage options in other areas.

Typical inverted roof construction



02 Roof deck construction

The introduction of a Blue Roof may have loading implications for the structure of the building. It is vital to consult a structural engineer at an early stage especially when designing for a SuDS solution where water will be attenuated within the roof structure.

Traditional structural loadings in roof design take into account the dead weight of the roof structure, the materials used to construct it, plus an allowance for loads applied by snow falling on the roof. Blue roofs attenuate collected water across the entire area of the roof at a shallow depth, typically less than 100mm. At full capacity this would exert a maximum additional load of 1.0kN/m2.

In reality it is exceedingly unlikely that the roof will ever reach full capacity as it will start to drain as a soon as it starts to rain and will continually drain throughout the storm event at the rate determined by the restrictor outlet.

Falls

03

This guidance document would suggest that zero fall as a minimum can be considered when constructing a Blue Roof, with appropriate precautions in line with BS 6229:2003 up to a maximum of 1:40.

A deck deflection survey on completion of the deck construction to ensure no back falls or depressions occur. A signed certificate of satisfaction provided by the installer of the substrate should be requested. If falls are to be used, these must be taken into account when calculating the effective storage void on the roof design.

04 Waterproofing selection

Each possible waterproofing solution will have merits and considerations for the designer. However each waterproofing solution should be measured against some basic core principles, for example:

— Thermal Effectiveness
— Aesthetics
— Waterproofing Integrity
— Structural Loading
— Construction Thickness

This guidance gives some information about two primary types of waterproofing construction, warm roof and inverted. It should be noted that other types of construction are available and their non-inclusion in this guide does not imply any comment on their suitability.

Warm roof insulation compressive strength must exceed the loads including safety factors for a fully saturated blue roof and the proposed surface finish. Insulation for inverted roof must be XPS, EPS or other and should have BBA or other notified body certification as an insulant for an inverted application. As the Insulation in an Inverted application is potentially subject to water immersion, it is suggested that the designer/specifier satisfies themselves that the selected product has suitable water absorption and thermal performance, as well as a satisfactory life expectancy in a Blue Roof application.

05 Waterproofing selection and certification

The selected waterproofing system must have a BBA certificate applicable to the design fall of the roof structure onto which it is being installed. If the Blue Roof construction has a finish where germination of any plant seedlings is possible the membrane should be tested and approved to the current FLL and Green Roof Organisation (GRO) guidelines.

In an inverted application, the storm water should be attenuated above the water flow reducing layer (WFRL). The manufacturer's recommendation for laps and detailing of the water flow reducing layer (WFRL) should be adhered to, reducing the amount of water that may possibly pass though this layer when greater heads of water are experienced during storm events.

In the case of inverted blue roofs, as there is no current test that can measure the amount of rainwater entering the space between the waterproofing and the WRFL, the default value, when calculating insulation correction value, for butted boards should be:

0.04 $Wday \bullet m^{-2} \bullet K^{-1} \bullet mm^{-1}$ (f=1)
or for a profiled board joint 0.03 (f = 0.75).

The BBA state that at upstands and penetrations the water flow reducing layer (WFRL) must be turned up to finish above the surface of the ballast layer and turned down at drainage outlets.

The WRFL can easily be damaged or displaced therefore great care must be taken in its design, installation and maintenance to ensure its long term effectiveness and integrity.

The roof design should minimise or eliminate penetrations in the area where water is to be attenuated, other than the rainwater outlets or emergency overflows that are required for drainage functionality.

06 Outlets and drainage

The designer should satisfy themselves that the number of outlets and positioning is suitable to provide effective drainage from the whole roof surface. The discharge rate of the outlets should be adjusted to ensure they can meet the required site discharge design. The Blue Roof discharge rate should be controlled in such a way that the release of any attended storm water is undertaken over a 24 hour discharge period, improving on the current SuDS legislation by 50%.

The choice of outlet is critical in a Blue Roof construction. The addition of a fitted flow rate restrictor will mean that the outlet will be subjected to higher water pressures than those used for gravity fed drainage and it could be fully immersed for long periods. Ideally this component will be manufactured with an integral flange of the waterproofing membrane to enable a homogenous seal to be achieved. Otherwise, the outlet must have a large connection flange and clamping ring to secure the membrane. The connection between the outlet spigot and down pipe has to be sealed and secure.

In a warm roof construction, consideration maybe given to a solution where the outlet, is locally isolated to prevent any possible water ingress from contaminating the insulation. This is achieved by forming a secondary seal between the vapour control layer and the underlay or the underside of the waterproofing, set 500mm back from the outlet.

In an Inverted application the drainage should be considered as needing to take place at three locations. The primary drainage is at water flow reducing membrane layer level. As the water flow reducing layer WFRL membranes are not a sealed layer of waterproofing, a secondary point of discharge should be incorporated at structural deck level to allow the discharge of any water which may pass through the water flow reducing layer WFRL, otherwise this water maybe permanently trapped beneath the thermal insulation, reducing its thermal performance. The third point of discharge should be the emergency overflows.

07 Emergency overflows

— Emergency drainage must be provided within the primary outlet or by a secondary method of drainage to facilitate the removal of excess rainfall if the designed capacity is exceeded, this should be placed at the top of the water attenuation layer.

— Consideration should be given to the proximity of trees or other sources of surface debris that could lead to blockage or restricted flow, if drawn into the outlet. Outlets should have inspection chambers fitted wherever possible and provision for regular maintenance where this risk is known or predicted.

— The outlet must have sufficient maintenance access to allow clearing of any debris, silt or sludge build-up that may occur around the outlet and impede drainage. A suitable inspection chamber should provide this function.

Blue Roof components

08

The Blue Roof, void forming components, thermal insulation and waterproofing must have the correct structural capacity to resist the permanent (dead) load of the required finishes and any temporary (live) loading produced by maintenance/emergency vehicles or other elements. The components should be designed to accommodate the full capacity of the predicted storm water for a 24 hour period.

All components must have chemical resistance to all potential hazardous material e.g. Fertilisers, petro chemicals and water bound pollutants carried in by rainfall typically from 4-9PH.

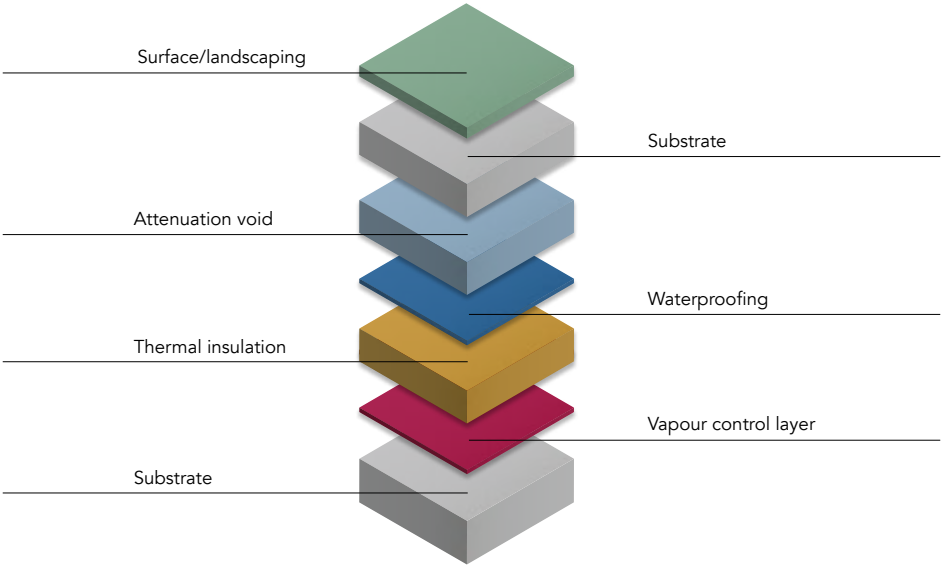
The Blue Roof must be designed to attenuate the predicted rainfall volume required to prevent ponding or flooding on the roof surface. The surfacing should drain by direct permeability or drainage channels linking into the blue roof system.

— Blue Roof components must be checked and signed off at all stages of installation by the manufacturer and certification kept in the Operation & Maintenance Manual.

09 Surface finishes

Blue Roofs should have a surface finish above the water attenuation layers, this surface finish can be constructed from any suitable permeable surface, to provide visual masking, protection of the system, filtration of airborne debris to prevent blockages and ballasting preventing wind uplift and flotation of the components. An impermeable surface can be used but adequate measures should be taken to ensure the water can filter into the Blue Roof attenuation void.

Typical warm roof construction



Waterproofing detailing 10

Waterproofing detailing should be carried out in line with the manufacturer's specific recommendations. It is recommended that if possible the, Waterproofing, Blue Roof and Surface Landscaping are considered as a complete system during the design phase. Manufacturer's solutions which provide all of these elements via one source, can ensure a cohesive design at this stage. British Standards and Systems Codes of Practice for waterproofing detailing, should be adhered to wherever possible and will provide a guideline to detailing principles, even if they are not specific to a Blue Roof application.

Minimum upstand heights of the waterproofing should finish 150 mm above the finished surface of landscaping, surface decking, ballast or paving. All waterproofing detailing should incorporate a suitable waterproof termination to the building structure.

If this height requirement is not achievable due to site design restrictions, the waterproof detailing must as a minimum exceed the heights of the emergency overflow and again be secured to the structure in a watertight method.

In a warm roof construction, consideration maybe given to a solution where roof penetrations are locally isolated to prevent any possible water ingress from contaminating the insulation. This is achieved by forming a secondary seal between the vapour control layer and the underlay or the underside of the waterproofing, set 250mm back from the penetrations.

11 Post installation inspection and maintenance

An electronic or suitable integrity test should take place on the completed waterproofing, prior to the installation of any Blue Roof void forming or landscaping components. The satisfactory waterproofing integrity certification must be retained and the testing company must operate to the guidance issued by the NFRC.

The waterproofing and Blue Roof system should be covered by individual reports confirming their installation in accordance with the design specification. These reports must be retained with the initial deck levels survey and integrity test certificates as part of the project Operation & Maintenance Manual.

The Waterproofing System is always installed as part of a surfaced finished roof, and therefore the only visible sign available for inspection, if any, will be a the upstands. Nevertheless in accordance with the guidance given in BS 6229:2003 it is recommended to carry out a twice yearly maintenance check, and whilst the individual system provider's maintenance procedures should be adhered to, a good recommendation would be to:

— Clear all debris from the roof surface, rainwater outlets, chutes, gutters etc. Debris must be removed from the roof and not simply flushed down rainwater pipes.

— Inspect the waterproofing system visible at all upstands, to ensure it is firmly adhered to the detail that it is waterproofing.

— Cut back tree limbs that overhang the roof to give a 1 metre clearance outside the roof edge. This will significantly reduce blockage of drainage ways due to fallen leaves.

— Ensure that all rainwater pipes are free from blockages and that water flows freely through them.

The building owner should keep a record of all inspections and maintenance carried out on the roof. Any signs of damage or degradation should be reported to the system provider so that arrangements can be made for remedial work to be carried out if necessary.

For more information

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