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CPD Article

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Blue Roofs: What are they and how are they used

Rainwater management has become a key consideration as part of building design processes. This is due in part to changes in the way we receive rainfall in the UK because of climate change, but also because of increased areas of hardstanding impermeable surfaces and landscaping.

Green roofs are already known for their ability to attenuate water, but this can now be enhanced with blue roof technology. Here the roof not only stores water but is also able to delay water discharge after a high intensity rainfall event and release it at a pre-determined rate. This topic will look at how this can be achieved practically and why this type of specification is likely to become more commonplace in the future.

Key Learning outcomes

- What a Blue Roof is
- Why and when they need to be specified
- The importance of calculations
- The components of a blue roof system
- Safety aspects to be aware of

1.0 What is a Blue Roof?

A Blue Roof can be created at either roof level or on a podium deck and is suitable for both warm and inverted roof applications. It should be designed to attenuate water for defined period after the end of a defined maximum rainfall event, typically 24 hours, and to discharge water at a predetermined rate through controlled rainwater outlets. It will have a void within its build up to store storm water and a surface finish which can either be a green roof build up or porous hard landscaping.

The key to a successful Blue Roof application is design, both in terms of the roof construction itself and the drainage outflow parameters for the site. The following is a summary of items to consider when a Blue Roof is proposed.

When specifying a blue roof, the message is not to improvise; the penalty for getting it wrong could be catastrophic. Although not an official requirement, it's not advisable to mix products from different sources but instead to use a complete system from one manufacturer if possible. It can also be beneficial to have the aid of a blue roof specialist, possibly from the manufacturer who can assist with design calculations using relevant rainfall data for the project location.

Most blue roof solutions, although designed to provide a similar end result, differ in their construction so it is very important for anyone carrying out installation to have received training for the specific system beforehand.

A blue roof is designed to store a large amont of rainwater for a given period of time and then release it slowly into the local surface water drainage system

2.0 Why specify a blue roof?

It is now widely acknowledged that we are living in a time of climate change with greater extremes, particularly of temperature and rainfall intensity being experienced. The effects of this phenomenon are being most felt in high density urban areas where over the years hard paved surfaces have replaced soft landscapes and the consequent higher rate of water runoff has sometimes resulted in increased flooding problems.

Over recent years SUDS (Sustainable Urban Drainage Systems) policies have been developed by local authorities which can result in water attenuation targets being imposed on new construction sites. This can often now be limited to typical greenfield run-off rates as low as 5 to 8 litres per second per hectare. The reason for this is that there may be no provision for the capacity of the local surface water sewer system to be increased where a new development is taking place. Limits may also be imposed if there is a history of localised flooding.

Surface water therefore, particularly during heavy rainfall, will need to be stored upstream on site and released more slowly into the local drainage system. This can often require large underground attenuation tanks to be installed on site with the attendant costs of groundworks and additional local services. There may also be limited space on a site for this solution to be practical.

It is becoming more well known that, apart from the environmental contribution they make, green roofs can play their part in this process. A typical extensive sedum or wildflower green roof will retain 50-60% on the rainfall it receives and discharge the remaining water more slowly than a non-green roof. However, there are situations where a controlled and measurable level of discharge from a roof is required and/or a greater temporary water storage capacity. This is where a “Blue Roof” may be a solution to reduce reliance on other forms of temporary storage.

Victoria shopping centre, Nottingham: A blue roof solution was chosen to maximise rainwater retention and control water run-off during heavy rainfall conditions

3.0 Blue Roof System Calculations

A full calculation can be carried out by the Blue Roof system manufacturer or a suitably qualified specialist to establish the water storage capacity required and outflow rates. To do this the following information will be required-:

- Rainfall intensity to be considered (I.e. 1 in 10 year, 1 in 50 year event) plus any percentage allowance for climate change.
- Maximum outflow rate allowed, in litres per second per hectare.
- Size of roof area(s) to be Blue Roof construction.
- Period over which water stored temporarily is to be discharged.
- Number of outlets proposed on each roof area.
- A roof plan clearly showing Blue Roof areas and outlet positions.
- Proposed specification for surfacing above the Blue Roof (I.e green roof, hard landscaping, stone ballast)

A blue roof can involve a hard landscape build up. Storage and drainage calculations are vital here, in order to provide the correct system to suit the project requirements

4.0 Construction and Drainage

Storing large quantities of water at roof level will exert significant additional weight loading on the roof structure. Although the water would be attenuated at a relatively shallow depth at maximum capacity on a typical Blue Roof the additional loading could be 100kg/m2. On new construction projects this can be factored into the design of the roof. However, on refurbishments the existing roof structure may not have been designed to accept this weight and may require strengthening, if this is possible.

The guidance contained within Code of Practice BS6229:2018 “Flat Roofs with Continuously Supported Roof Coverings” should be considered by specifiers. It should be noted, however, that blue roofs will generally require zero drainage falls to operate at an optimum level. Guidance should therefore be sought from the chosen waterproofing system manufacturer or supplier in this regard. A waterproofing system should be chosen which has a BBA certificate for use with zero-degree drainage falls or for the design falls proposed. If there is to be a green roof over the storage boards the membrane should have been tested and approved to current FLL and Green Roof Organisation (GRO) guidelines as being root resistant and suitable for use within a living roof.

Blue Roofs should always have a surface finish above the attenuation layer. This can either be a soft vegetated landscaping, hard landscaping or possibly stone ballast. The surfacing chosen should ideally be porous and provide sufficient ballast weight to prevent wind uplift and floatation of the Blue Roof components. It should be borne in mind that if a vegetated surfacing is used it will provide further attenuation above the Blue Roof system itself.

A suitable integrity test should be carried out on the waterproofing layer immediately prior to the Blue Roof system being installed. The installation of the Blue Roof should then be inspected prior to the surface finish being added.

As with other flat roof designs penetrations through the waterproofing layer should be kept to a minimum. Where they are required, for example for restraint systems or barriers and handrails, they should be correctly detailed in accordance with the waterproofing manufacturers design guidance. When designing penetration details on blue roofs an allowance should also be made for the depth of the system build-up and its surface covering to ensure sufficient upstand height is achieved above the finished roof surface level.

Designed and installed correctly, a blue roof can provide a very successful surface water management solution for the modern construction project.

5.0 Safety Aspects

The outlet is a very important part of a Blue Roof system. A control feature will be added to a standard rainwater outlet to restrict the flow of water through the outlet itself so that that water attenuated temporarily can be discharged over, typically, a 24-hour period. This feature will have been optimised to suit flow calculations for the roof and may also be adjustable.

Emergency overflows should be incorporated into the design to remove excess rainwater if the design capacity is exceeded or an outlet becomes blocked. Outlets should be situated inside inspection chambers and be easy to maintain on a regular basis.

As with green roofs, the subject of fire safety is very important when it comes to the design and specification of blue roofs. It is important to ensure that all roof materials satisfy building regulations for safety. Correctly designed , installed and maintained blue roofs can make a positive contribution to resistance to spread of flame on a roof area. In the case of roofs with a vegetated covering it will be important to incorporate pebble fire breaks at perimeters and penetration details such as rooflights, outlets and pipes. The GRO (Green Roof Organisation) Green Roof Code makes specific recommendations regarding fire break design.

Where vegetation includes tall grasses or wildflower species that die back seasonally leaving volumes of organic material on the roof in the form of spent foliage, it is important that correct maintenance procedures are followed to prevent a negative impact on fire risk.

Architects, civil engineers, urban planners and water management experts need to look at the potential blue roof solutions offer to new and existing roof areas, especially in high density urban areas.