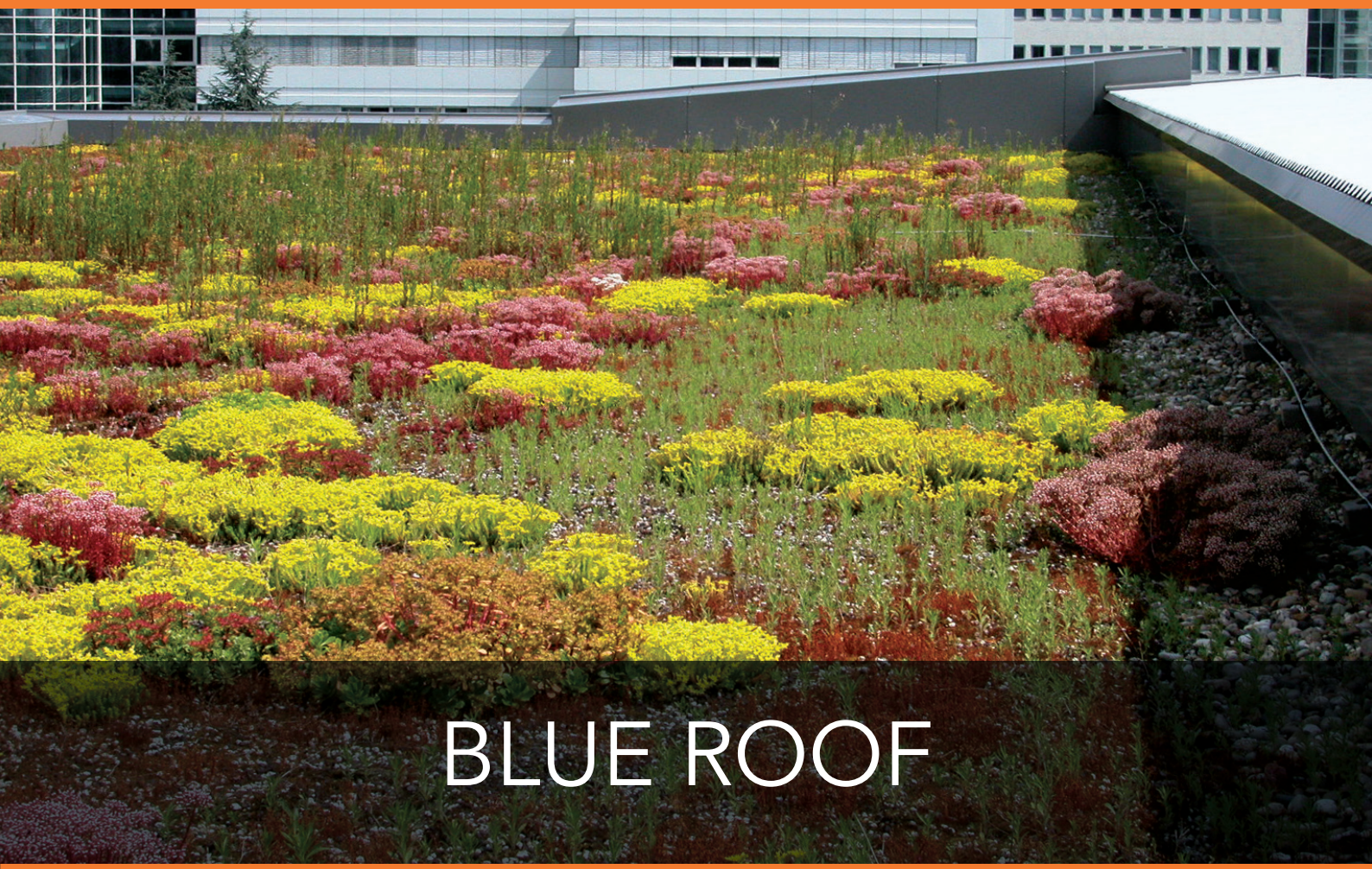
BAUDER



BLUE ROOF

DESIGN CONSIDERATIONS

OVERVIEW

Development and expansion of towns and cities has seen exponential use of impervious surfaces causing artificially high rates of rainwater runoff. With the trend of urban growth coinciding with an ever increasing number of 'extreme' weather events, flooding is becoming a common and expensive problem.

The key sustainable urban drainage solution (SuDS) design is the principle of dealing with rain water as close as possible to where it falls. This means that blue roofs are now fundamental to many drainage plans. A blue roof controls and limits the rainwater flow from the roof ensuring that the drainage system below is not overwhelmed.

The Bauder Approach

Bauder will work with the client, architect and drainage engineer to provide a single point solution for waterproofing, blue roof and green roof layers, and system guarantee.

Bauder will produce a specialist report and calculations to determine the most effective scheme for the project using the following key data from site:

- Geographical and climate data for the project address.
- Allowable discharge for the roof.
- Maximum attenuation volume on the roof.

The Bauder report will provide the following information:

- 1:100 year storm profile for the roof (+40% factor for climate change).
- Number of outlets required, complete with an assigned number of control holes, restricting the flow of water in line with the discharge rate for site.
- The depth of void required on the roof on to which any landscaping finish can be installed (referred to as the H-Max).

This information will then be drawn up into a specification for the project complete with compatible waterproofing layers, blue roof system and landscaping/green roof layers.

Contents

Specification Support

Specification downloads:
www.bauder.co.uk/technical-centre

Telephone helpline:
0845 271 8800

1 LEGISLATION AND DRIVERS

Sustainable Urban Drainage is now part of legislation and is a critical part of planning. Blue roofs form part of the options available for SuDS.

The Flood and Water Management Act 2010 was introduced in England and Wales and implemented to better manage flood risk. The Act creates safeguards against rises in surface water drainage charges and protects water supplies for consumers. The Act gives levels of responsibility to local authorities to co-ordinate flood risk management in their area.

Many local planning authorities (LPAs) are adopting early perspectives that encompass Schedule 3 of the Act to bring in measures that prevent flooding. Within construction and development, planners are restricting the amount of rainwater leaving a site via the drainage system, limiting water egress to 5-10 litres per second per hectare, the same flow rates for regional greenfield sites.

The Environment Agency and lead local flood authorities provide data and flood maps to assist drainage engineers and architects identify the level of risk by categorising the possibility and hazard levels of flooding by zones.

The zones are:

Flood Zone 1 – low probability, where land has a less than 1 in 1,000 annual probability of river or sea flooding.

Flood Zone 2 – medium probability, where the land has between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.

Flood Zone 3a - high probability where land has a 1 in 100 or greater annual probability of river flooding; or having a 1 in 200 or greater annual probability of sea flooding.

Flood Zone 3b classifies functional floodplains where land is identified to receive waterflow to be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.

Flood zones 2 and 3, have water discharge management implications with zone 3 having the strictest regulations and will be subject to levels of flood defence and discharge management resulting in the type of construction permitted.

The Government publishes information and advice on how to take account of and address the risks associated with flooding and costal change in the planning process. For more information on this please go to:

https://flood-map-for-planning.service.gov.uk

Example flood map below:

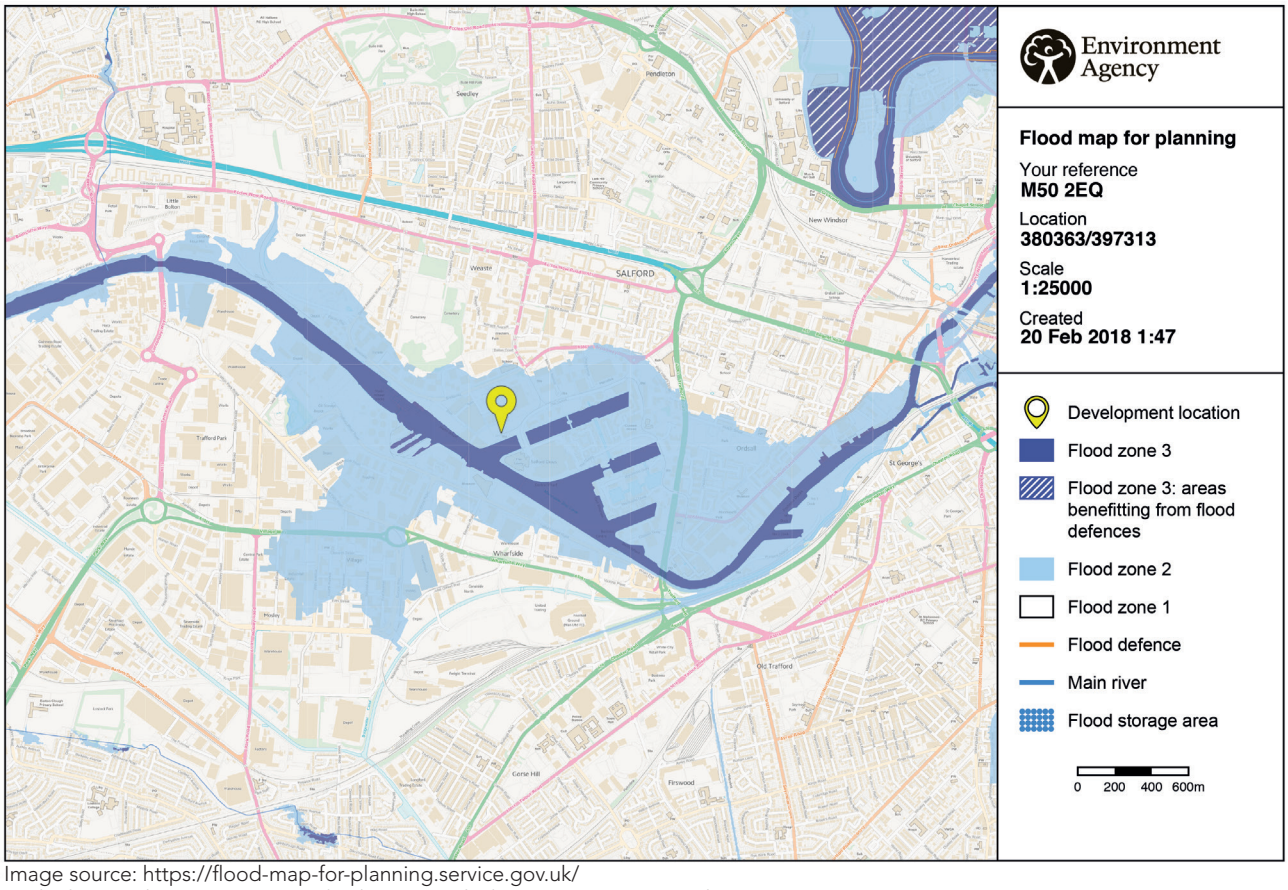


Image source: https://flood-map-for-planning.service.gov.uk/
Under licence: http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/

DESIGN OF A BLUE ROOF 2

The incorporation of a blue roof into a project can be at rooftop or podium level. A blue roof is designed to attenuate storm water within a void which sits directly above the waterproofing layer and beneath a surface finish such as a vegetated green roof or hard landscaping.

A blue roof should not be designed as a water storage facility but should allow all the water to evacuate from the roof over a 24-hour period from the end of the projected maximum rainfall event, with over half of the attenuated water having evacuated from the roof after a 12-hour period.

Key aspects for inclusion

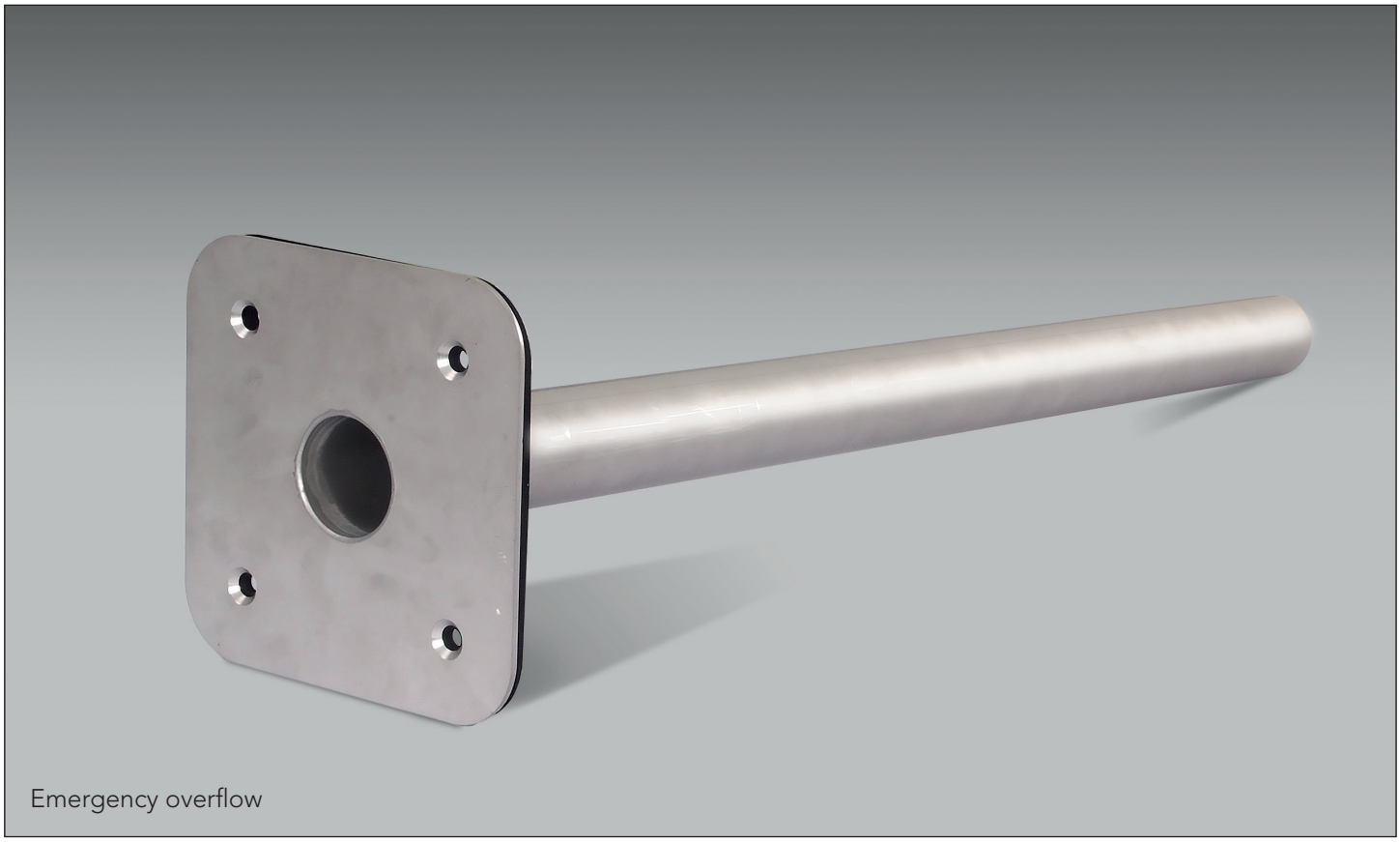
1. **Single Point Source and Guarantee.** Consider the waterproofing, blue roof and surface design finish as one element, to ensure compatibility and guarantee clarity.

2. **Void Space.** Water flow in the blue roof void space must be multi-directional and free flowing above the waterproofing membrane, that is, no baffles or structures designed to divert flow on the roof surface.

3. **British Standards.** Adhere to the British Standards and Systems Codes of Practice for waterproofing and roof detailing, with waterproofing upstand heights ending standing 150mm above the landscaped / surface finish, including suitable termination to the building structure.

4. **Roof Penetrations.** The blue roof design must 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. In some instances, it may be possible to individually isolate the roof penetration from the blue roof to prevent any possible water ingress 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.

5. **Emergency Overflow.** Designed as an emergency overflow (example below), unconnected to the blue roof outlet flow restrictor, to discharge the rainwater should the maximum height of the blue roof design void be exceeded.



Emergency overflow

3 DRAINAGE

The discharge rate for the site is set by the local planning authority (LPA). Many LPAs are setting limits that equal that of greenfield run-off rates, 5 – 10 litres per second per hectare. Determining the total allowable discharge for the site is critical and will have been determined at planning stage. Once this is defined, the percentage of permeable and impermeable surfaces (roof, roadways, paving etc) is calculated so that the correct roof discharge rate can be worked towards.

As SuDS can take various forms, the blue roof may be included to supplement other methods, or designed as the sole solution. The blue roof may be designed to accept a higher or lower percentage of the controlled discharge depending on other attenuation or storage options available in other areas of the site.

ROOF DECK CONSTRUCTION 4

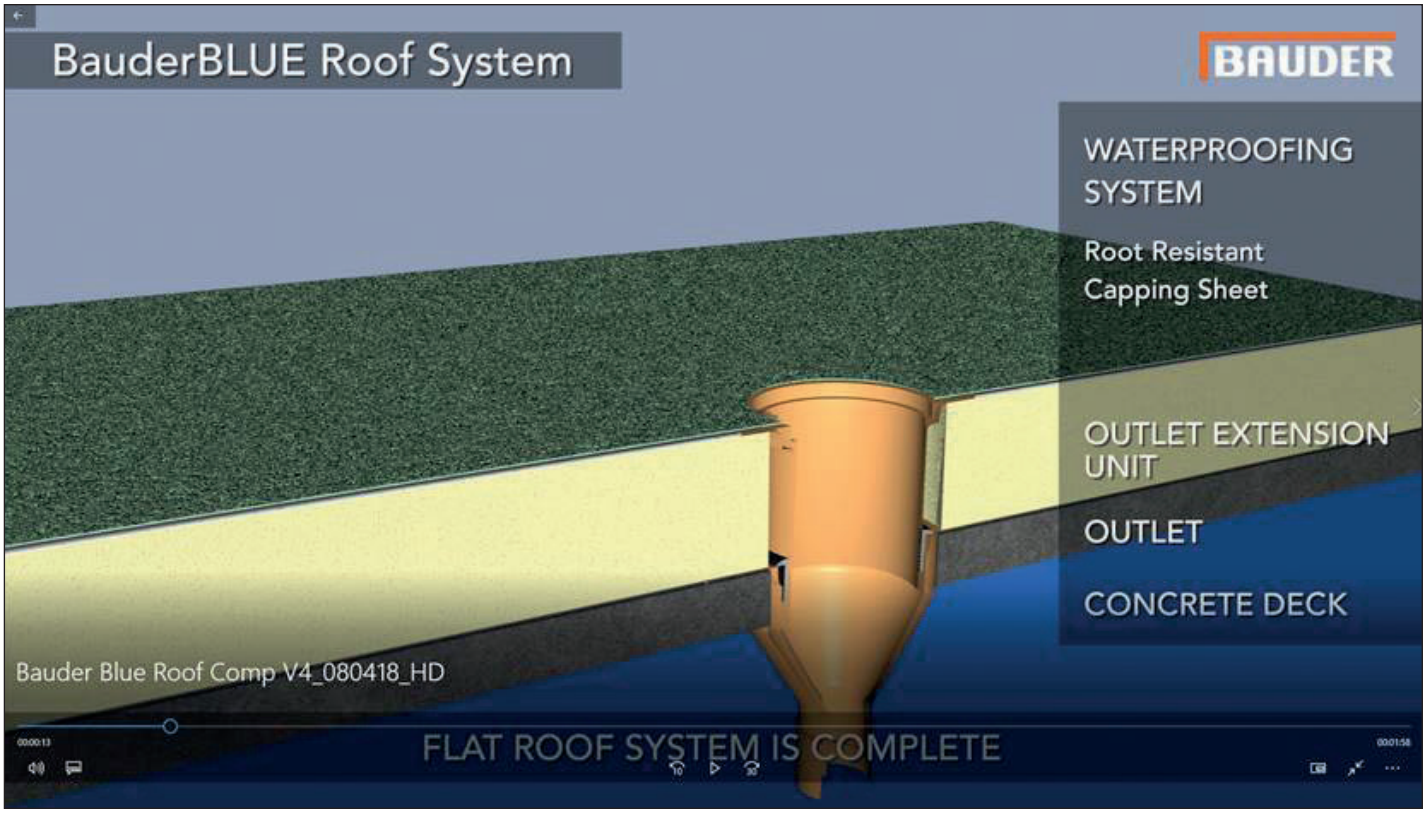
The implementation of a blue roof will have considerable loading implication on the roof and its waterproofing. The roof deck construction will need to be designed not only to accept the dead and imposed loads*, but also the weight loading associated with the water to be attenuated on the roof.

As an example, at a depth of 100mm, a blue roof would exert an additional load of 1.0kN/m². Calculations must also consider the finish above the blue roof, be it a green roof, landscaped area or paved roof. Calculations must use saturated weights of all components and imposed loads, such as access by people and vehicles. It is strongly advised that the project structural engineer be involved throughout the design of the SuDS solution, and particularly when a rooftop solution is to be included.

A blue roof can be designed on zero falls providing the waterproofing system holds relevant certification and the roof is designed in accordance with British Standards. The Bauder systems used when constructing a BauderBLUE Roof have been BBA certified to be used on zero falls, with the appropriate precautions under BS 6229:2018, and up to falls of 1:40.

When the deck construction is complete, a deck deflection survey should be carried out to ensure the accuracy of the construction and that no depressions or back falls occur. Certification should be gained before the installation of the blue roof proceeds.

Any falls created should be taken in to account as they will impact on the effective void space for holding rainwater.



*Dead and imposed loads - should be calculated in accordance with BS EN 1991-1-1, BS EN 1991-1-3 and BS EN 1991-1-4 and should include the weight of the roof structure, waterproofing system, plus an allowance applied for snow load.

5 WATERPROOFING SYSTEM SELECTION

Consideration must be given to the appropriate form of waterproofing so that it can meet the demands placed on it by the blue roof, as such performance characteristics for durability and thickness of membrane (density), tensile strength (EN 12311-1) and elongation at break (EN 12311-1) need evaluation before appropriate selection can be made. The system should have the correct structural capacity to resist the dead load of the required finishes and any imposed loading produced by maintenance or emergency vehicles or other elements.

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.

Our blue roof solutions utilise two robust waterproofing constructions; a bituminous warm or cold roof build-up with the Bauder Total Roof System (Green for soft landscaping) or a Bauder Hot Melt cold roof construction. Both systems carry BBA certification and are suitable to maintain the integrity required for blue and green roof applications.

PAUSE FOR THOUGHT

At present there is no British Standard or other approved way of calculating the thermal loss due to the blue inverted roof. However, the increased thickness due to rainwater cooling will be more than the minimum 10% increase as advised in BS6229:2018 for a conventional inverted roof.

Insulation within a waterproofing system

Warm roof construction with Bauder Total (Green) Roof System

The thermal effectiveness of the roof will not be impacted by the blue roof, but it is critical that the compressive strength of the insulation must exceed the maximum expected imposed loads for maximum height (H-Max) of the water within the blue roof element and the saturated weight of the roof finish.

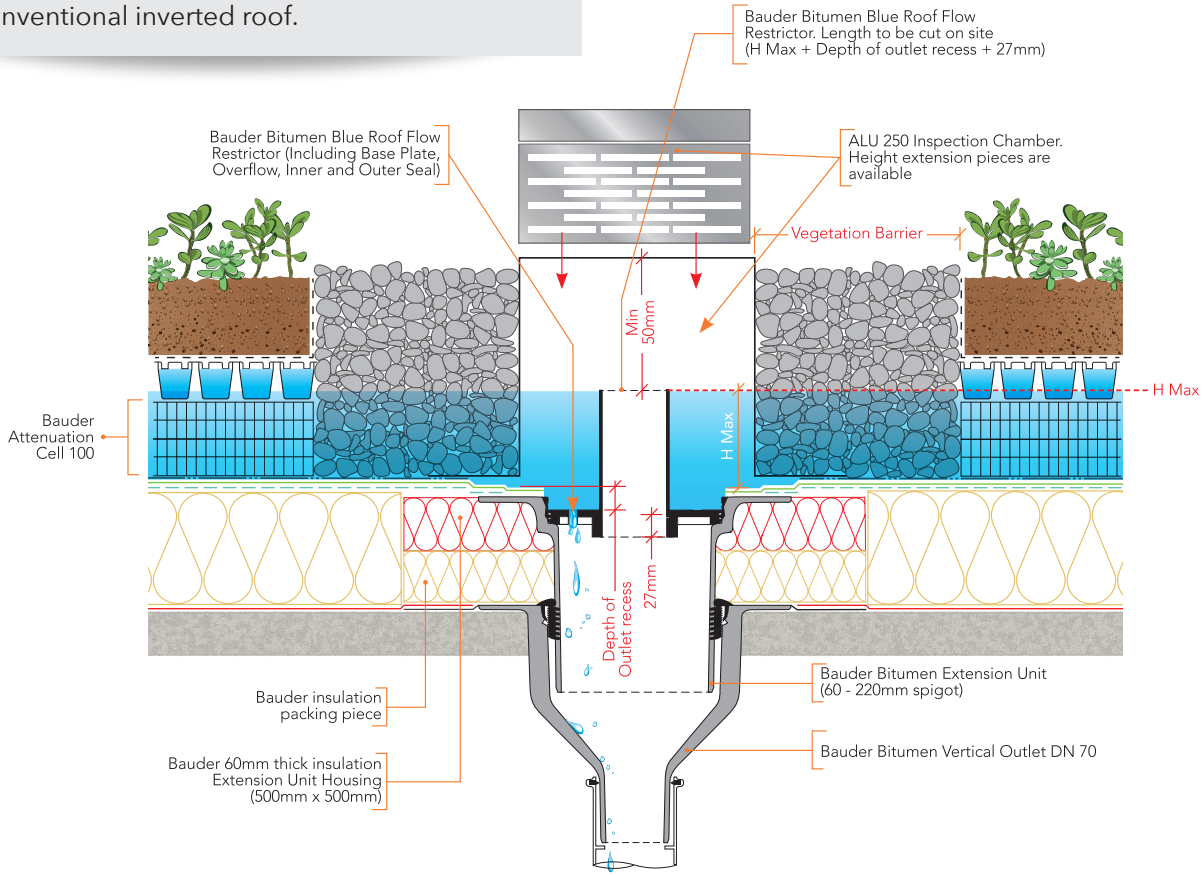
Cold roof construction with Bauder Total Roof System or Bauder Hot Melt

The thermal effectiveness of the construction will have been included within the building rather than included in the waterproofing system.

Inverted Roofs

Bauder does not offer an inverted blue roof system as it is highly unlikely that an inverted blue roof will achieve the U-Value required by building regulations.

Deflections within a concrete slab often lead to ponding on the roof, with outlets being positioned close to walls or pillars. As the insulation is fully encapsulated within a warm roof build up, this ponding does not lead to any loss of thermal performance/U Value. In a normal inverted system an allowance is made for a small amount of trapped water; however, these calculations do not assume any deflections. Under storm conditions the restricted flow of the outlet will create pressure, and force water both beneath and in-between insulating layers, and thus causing some loss of thermal performance and runs the risk of flotation.



The design of every blue roof is individual to the geographical location, construction project and the total allowable discharge defined by the LPA within the planning approval.

The calculations for drainage requirements are a specialist discipline and should only be carried out by a qualified professional. Bauder produces roof specific discharge reports for the blue roof specifications we are engaged with.

Blue roof outlets should have easily accessible inspection chambers fitted for regular maintenance to ensure the outlet is free from blockages.

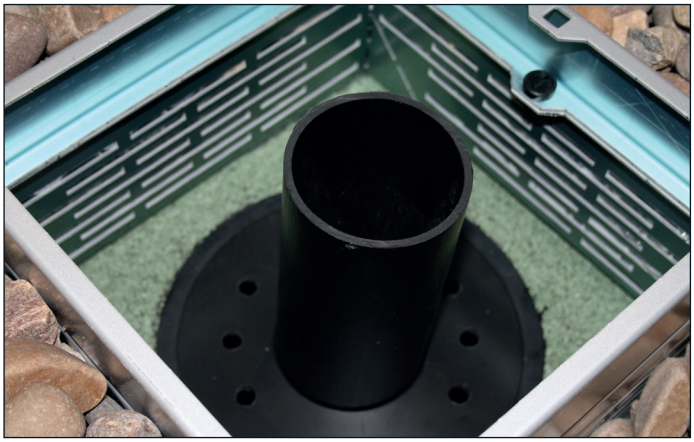
Restrictor Outlets
The design, manufacture and installation of a flow restrictor and outlet is critical to the success of a blue roof as the outlet will be subjected to greater water pressures than standard gravity-fed drainage and it could be immersed for longer periods.

The flow restrictor component should be manufactured with an integral flange of the waterproofing membrane to enable a homogenous seal to be achieved. The connection between the outlet spigot and down pipe must be sealed and secure.

Emergency Overflows
Emergency drainage will be provided with the primary outlet and a secondary method of drainage to facilitate the removal of excess rainfall if the designed capacity is exceeded.

The emergency overflow outlet will be specified and the base of the overflow pipe should be placed level with the top of the void height or H-Max.

Maintenance access is important to allow for clearing of any silt, debris, or leaf and plant matter which could block or restrict the flow of water through the emergency outlet. This is particularly important if trees are located nearby, as they can be a frequent source of material.



7 BLUE ROOF COMPONENTS

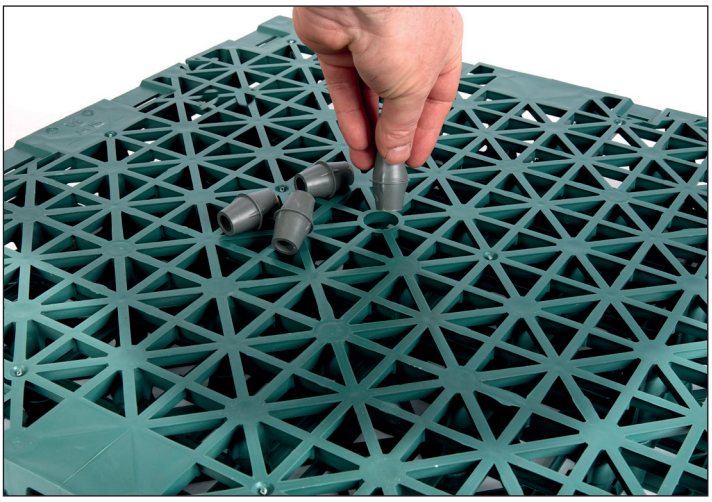
As the waterproofing and insulation must have the correct structural capacity, so too must the void-forming components of the blue roof so that in unison they can resist the permanent load of the required finish and any imposed loading.

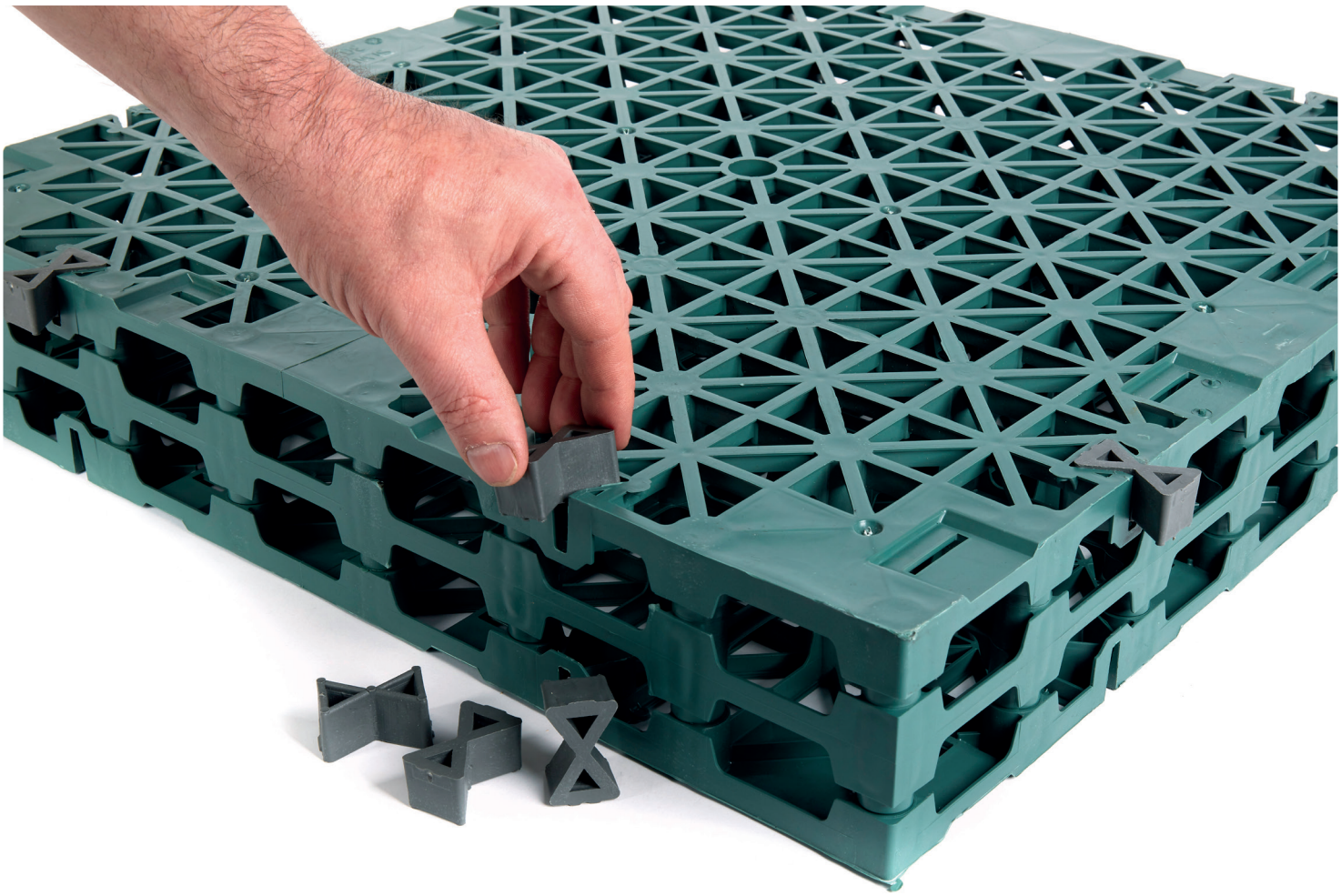
The void-forming components must meet the following requirements:

- Have the capacity to fully accommodate the predicted storm water for a 24-hour period.
- Be resistant to chemicals such as fertilisers, petro-based compounds and water bound pollutants carried in by rainfall typically from 4-9pH.
- Allow free-flowing movement of water to the flow restrictor outlets
- Be designed to sit beneath the surface finish and be able to prevent any ponding or flooding occurring on the surface finish.

The Bauder Attenuation Cell 100 delivers all the requirements for void forming on a blue roof.

As with all roofing components, the blue roof, green roof, and landscaping elements need to be checked and signed off. A BauderBLUE Roof will be verified by a Bauder site technician and this sign off forms part of the roof guarantee.





SURFACE FINISHES 8

A BauderBLUE Roof System will have an aesthetically pleasing surface finish that protects the system from damage, wind uplift, airborne debris and matter, and flotation of the components.

The surface finish will be able to freely drain in to the attenuating void space without submitting to ponding water or flooding.

Suitable permeable surface finishes are:
- Paving or decking on a pedestal support system.
- Extensive green roofs, such as sedum or wildflower systems.
- Intensive green roofs, such as lawns, planters and more substantial planting.

Impermeable surface finishes require approaches to ensure the water can drain or filter in to the blue roof void space so that attenuation of rainwater can occur.

9 WATERPROOFING INSTALLATION AND DETAILING

British Standards and Systems Codes of Practice for waterproofing detailing should be followed and will provide a guideline to detailing principles, even if they are not specific to a blue roof application.

The minimum recommended height for constructing waterproofing details is 150mm above the finished surface of the landscaping, surface decking, ballast or paving. All waterproofing detailing should incorporate a suitable waterproof termination to the building structure.

In a warm roof construction, consideration may be 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 any penetrations.

PAUSE FOR THOUGHT

Doorway thresholds are the exception with an upstand height requirement of just 75mm as described in BS6229:2018.

POST INSTALLATION INSPECTION 10

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

A BauderBLUE roof will have the waterproofing system and blue roof system inspected by our site technicians who will produce individual reports confirming the installation of the system is in accordance with our recommendations and specification.

11 MAINTENANCE

Maintenance of a blue roof is critical to the viability to its function. It is recommended that:

1. Following any significant storm event, the outlets should be visually inspected to ensure no blockage has occurred.
2. Following any significant traffic or remedial works that take place on or around the roof, each of the outlets should be visually inspected to ensure all drainage holes are clear and free draining.
3. Quarterly each outlet, should be inspected and cleared of any build up or debris. All leaf litter mainly autumnal visit, should be removed from the roof surface. Debris must be removed from the roof and not simply flushed down rainwater pipes.
4. Cut back tree limbs that overhang the roof to give at least a 1 metre clearance, this will significantly reduce any risk of any blockage to outlets.

It is also recommend during maintenance visits to visually inspect the waterproofing system at all upstands, to ensure it is firmly adhered to the detail that it is waterproofing.

For further Blue Roof Design Guidance, please contact Bauder Ltd or refer to the NFRC Technical Guidance Note for the construction and design of Blue Roofs.

Get your specification right

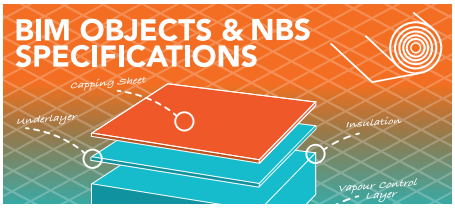
bauder.co.uk/technical-centre

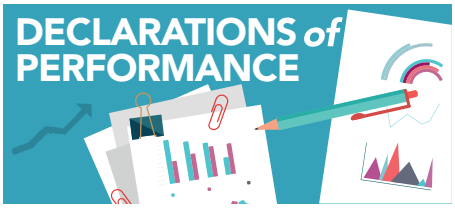
Technical Centre
BIM objects and NBS specifications
CAD detail drawings
System summaries
Certification
Declarations of Performance
Products
Design guides
Brochures
BRE Green Guide
Maintenance advice
Technical CPD seminars

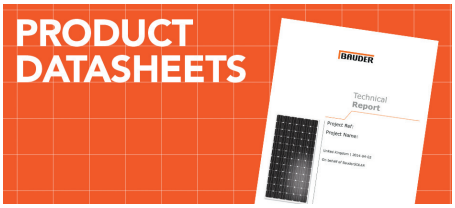
Online technical resources for your flat roof project

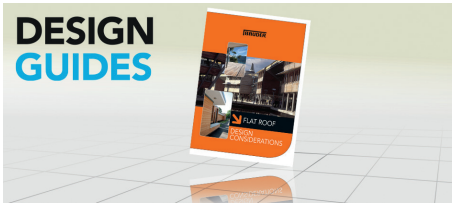
At Bauder our service is free to you and covers all elements for a successful project delivery from initial concept or site survey, through to specification package with bespoke drawings and calculations, on site monitoring and final sign-off and handover.

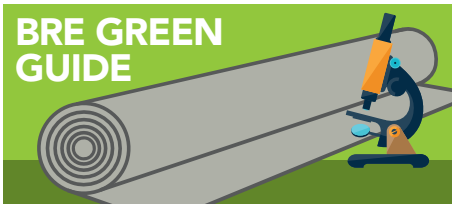
We appreciate that there are times when you need resources to get your project started and the Bauder Online Technical Centre will support you.

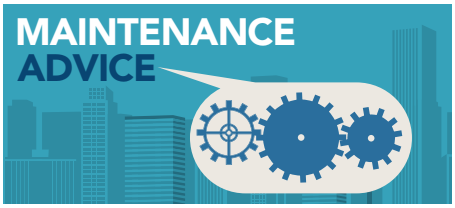




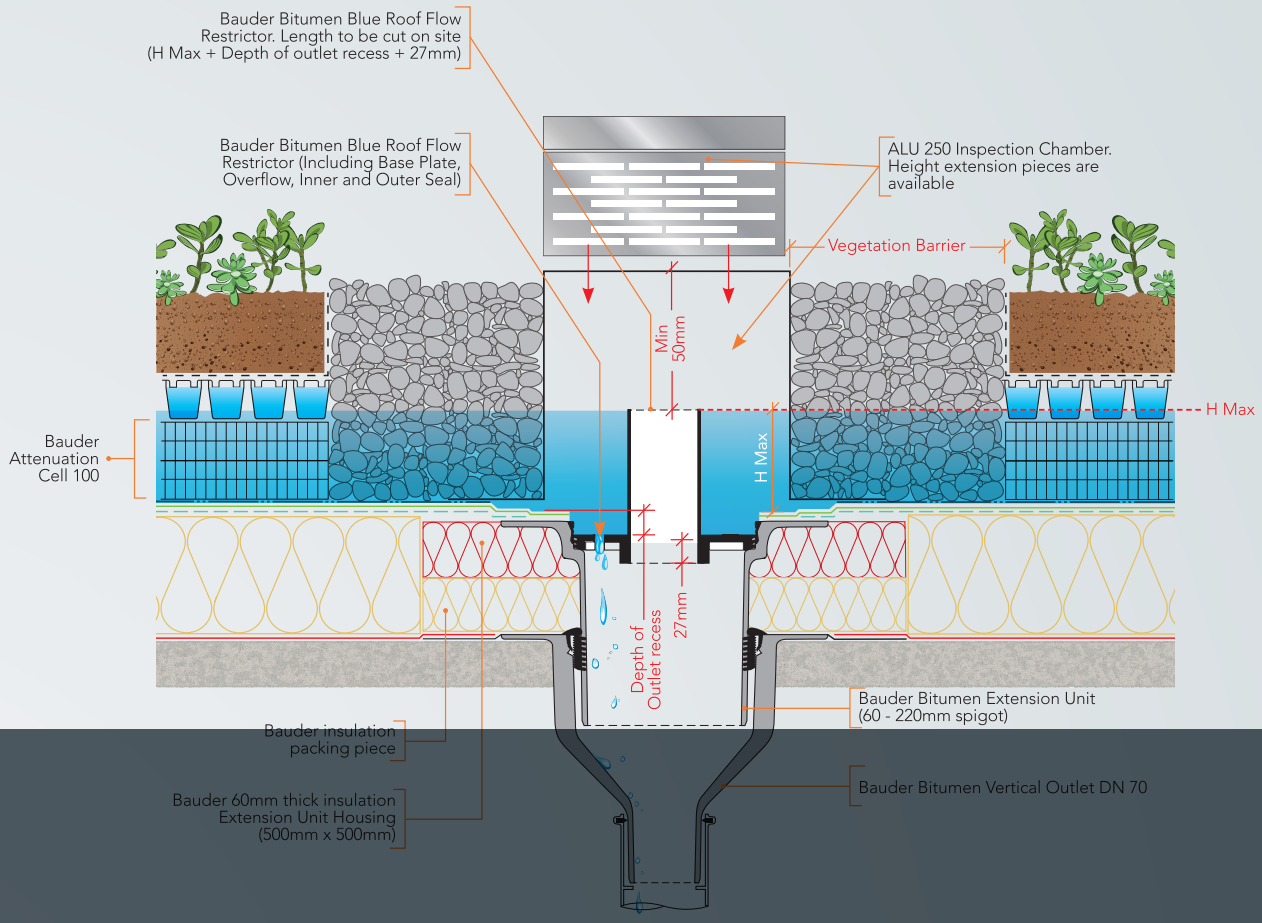








Specification Hotline: 0845 271 8800



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