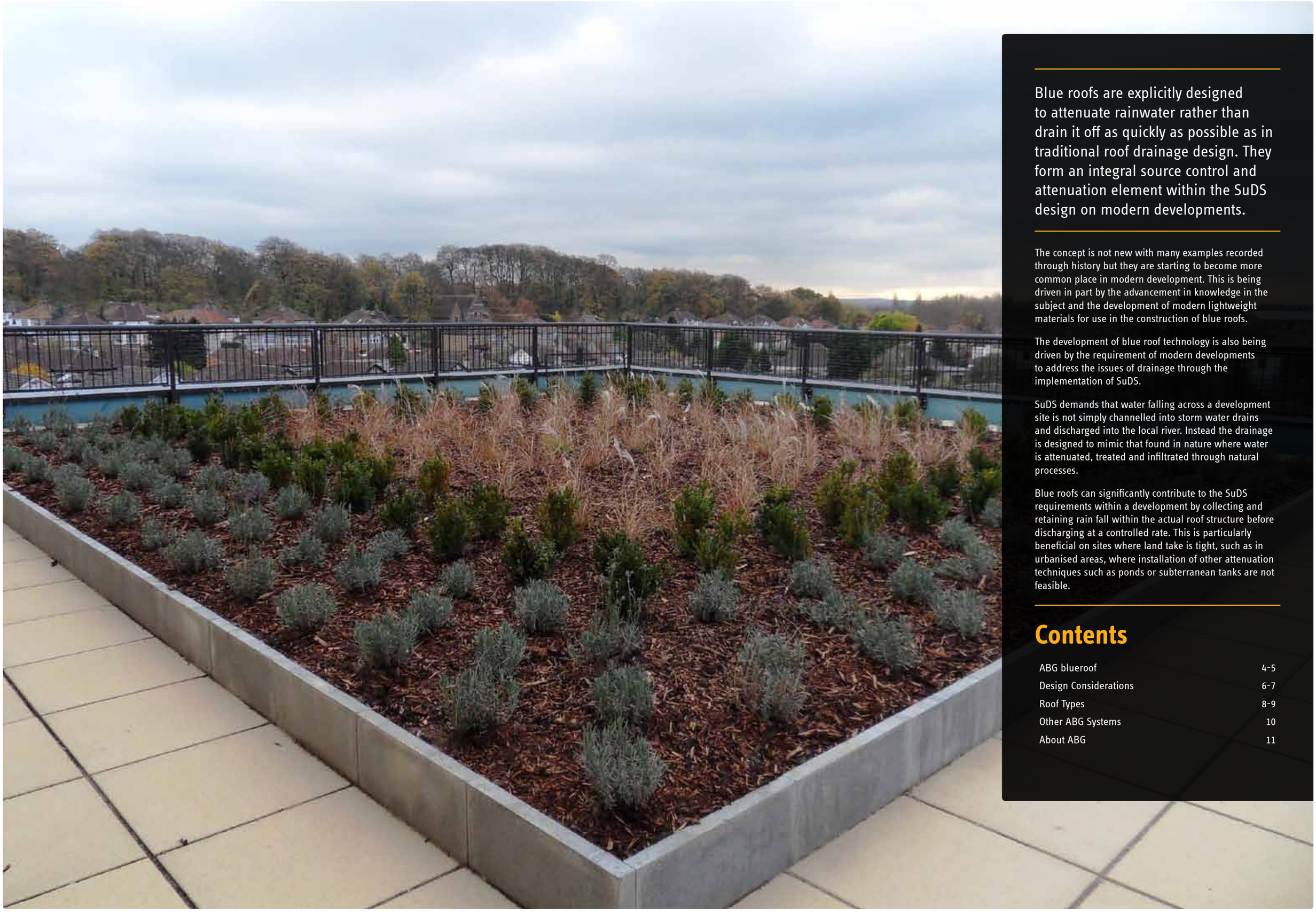
blueroof

A guide to the selection and specification of ABG blue roof system for the attenuation of storm water.

abg creative geosynthetic engineering



Blue roofs are explicitly designed to attenuate rainwater rather than drain it off as quickly as possible as in traditional roof drainage design. They form an integral source control and attenuation element within the SuDS design on modern developments.

The concept is not new with many examples recorded through history but they are starting to become more common place in modern development. This is being driven in part by the advancement in knowledge in the subject and the development of modern lightweight materials for use in the construction of blue roofs.

The development of blue roof technology is also being driven by the requirement of modern developments to address the issues of drainage through the implementation of SuDS.

SuDS demands that water falling across a development site is not simply channelled into storm water drains and discharged into the local river. Instead the drainage is designed to mimic that found in nature where water is attenuated, treated and infiltrated through natural processes.

Blue roofs can significantly contribute to the SuDS requirements within a development by collecting and retaining rain fall within the actual roof structure before discharging at a controlled rate. This is particularly beneficial on sites where land take is tight, such as in urbanised areas, where installation of other attenuation techniques such as ponds or subterranean tanks are not feasible.

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ABG **blueroof**

ABG **blueroof** provides attenuation capacity within the green roof or podium deck construction of a development. Utilising this space in this way means that the attenuation capacity required to meet SuDS best practice can be met without the requirement for land consuming ponds and retention basins or the challenges of constructing large subterranean geocellular storage tanks.

blueroof comprises a combined drainage and attenuation void within the roof structure and a roof outlet system designed to release the attenuated water at a controlled discharge rate as permitted in the planning consent of the site.

Designing a green roof in this way allows storage capacities suitable for up to a one in a hundred year storm event, plus an allowance (typically 30%) for the effects of climate change, to be achieved.

This stored water, as with a 'traditional' storage system, can be released at a controlled rate or even used as grey water or irrigation for the vegetation across the development.

The ABG **blueroof** System consists of two key components:

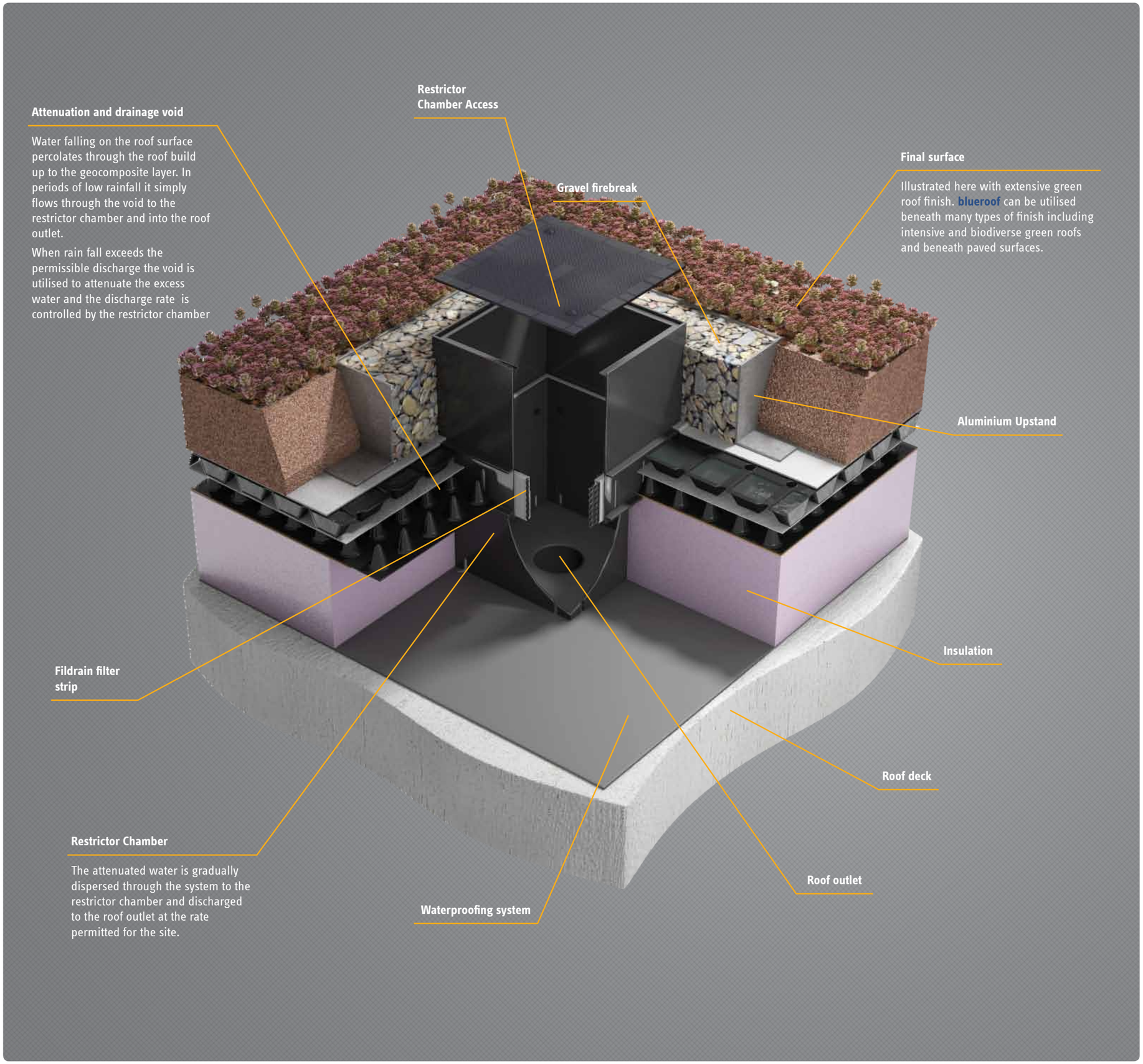
- A drainage geocomposite system with integral filter geotextiles and a series of restrictor chambers. Excess water not absorbed by the vegetation, filters through the green roof and builds up in to the drainage void formed by the geocomposite layers below.
- This water is gradually dispersed through the system to the restrictor chamber and discharged to the roof outlet at the rate permitted for the site.

The storm water attenuation requirements are met within the roof construction, therefore the need for underground storage can be eliminated. The benefits to the overall project include the removal of the excavated material, disruption on site, and the time and cost of installing an underground tank.

Placing the storage within the footprint of the building also has advantages in heavily urbanised developments where external space is at a premium and on site working space and materials storage is limited. This reduction in material movements also helps reduce the carbon footprint of the project.

blueroof is suitable for:

- Supermarkets
- Distribution centres
- Schools and colleges
- Shopping centres
- Underground car parks
- Housing
- Flats
- Office blocks



Design Considerations

Design Factors

As part of the design process ABG will develop response calculations to model the behavior of the roof during storm events. The information required is usually contained within the surface water run-off assessment for the specific site.

The modelling looks at a number of key factors including

- Required rate of discharge.
- Attenuation volume requirement.
- Time to completely discharge attenuated water from the roof structure.
- Roof type.

Rainfall depths for the specific site are calculated according to location, duration and return period (the number of times in set period a storm of that magnitude is likely to occur; 1 in 30 years and 1 in 100 years storms are usually considered). An allowance is also made for future climate change.

Rainfall and run-off should be considered simultaneously to give an actual representation of the **blueroof** behaviour under storm conditions.

Design Capacity

Should attenuation reach its maximum level the restrictor chamber has a built in safety mechanism designed to release excess water into the drainage system. Design capacity will always come with a factor of safety allowing for additional capacity.

In reality, provided the **blueroof** is designed and maintained properly, its designed storage capacity will never be exceeded.

Outlet Design

Traditional roof design tends to have a conservative approach when designing the rainwater outlets with usually more outlets installed than actually required. When designing a blue roof the restrictor chambers are an integral component in controlling the discharge of water from the roof and as such the number required is calculated exactly. Typically this may mean that less outlets are required, less outlets means less penetrations, less detailing and greatly reduces the potential of leaks occurring. The reduction in outlets also has a positive impact on both the construction time, costs and service risers running through the building meaning the construction saves both time and money.

Water Quality

Using the **blueroof** system has a positive impact on the quality of the water discharged. Before the water reaches the roof outlet it has already passed through several processes that remove particulates and pollutants including vegetation and growing medium (if the roof is green) and more importantly through at least two, in a basic system, layers of non-woven, needle punched geotextile whose filtration properties are well documented. The water is treated to such a degree that it reaches the level required in treatment train stage one allowing the water to be released from the roof directly into the river system

In a truly holistic design consideration should be given to using the attenuated water for secondary uses such as the irrigation of gardens and washing paths etc. The water could also be considered for grey water reuse applications although it may need to undergo a further treatment stage in order to do so.

Structural Considerations

The introduction of a **blueroof** 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 stored within the roof structure. This will enable you to determine any constraints you may be under, although this is not as onerous as may be expected.

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 load applied by snow falling on the roof.

blueroof stores 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/m^2.

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.

When taking into account that there is no screed required to achieve a fall on the roof and construction tolerances the additional design allowed for load is, in fact, usually negligible.

ABG Technical Department are able to advise on the loadings the roof will generate when fully charged.

Waterproofing Design

A key element of any roofing system is the waterproofing. **blueroof** is compatible with all modern waterproofing materials (ABG recommend monolithic bonded systems). The selection of which waterproofing type is down to the type of roof construction and, to a degree, personal preference. As a concept **blueroof** is compatible with both warm and inverted roof constructions.

Once installed it is recommended that the waterproofing layer be electronically tested for integrity before being covered installation of the blueroof components commences.

Care should be taken during installation of subsequent layers however once the insulation is installed the waterproofing system is covered and protected from damage from further works during normal operations.

As with other roof types the waterproofing should be detailed to a height of 150mm higher than the final fill level.

ABG work with leading manufacturers and installers of waterproofing systems and can offer project specific advice and guidance to ensure the optimum solution is selected.

Access and Maintenance

The British Standards Institution state that all new builds must provide access to the roof area to enable a minimum of two inspections per year. In achieving this compliance to working at height regulations must be considered. If a building is of a height which can cause an injury from a fall, including roofs under 2m, then edge protection is required.

The level of maintenance required is dependent on the final finish. Paved podium decks and extensive green roofs are relatively low maintenance where as intensive green roofs require maintenance like any garden.

Specific attenuation should be given to the **blueroof** elements such as the outlets which should be checked a minimum of twice annually.

As with any green roof the design should allow for the safe removal of materials from the roof

Thermal Performance

blueroof needs to meet the building regulations required to achieve the thermal performance. At the moment, as with green roofs, the **blueroof** build up cannot be considered as part of the roof build up when calculating thermal performance so insulation specification must be done as per a traditional roof design.

It is recommended that the insulation material be extruded polystyrene (XPS) and not expanded polystyrene (EPS). EPS in contact with water degrades which will result in the roof losing thermal performance ultimately leading to the requirement for an expensive reroofing operation.

However, research shows that the introduction of layers of drainage, growing media and vegetation have an impact on the thermal performance and can offer additional benefits on the development including cost benefits and reducing the carbon footprint.

Geography

Geographical location and orientation are an important part of designing a **blueroof**. Which area of the country, the amount of average rainfall in that area and the prevalent wind direction all affect the design and must be considered.

When using a vegetated finish the geographic location impacts the species selection with many species suitable for green roofs being specific to a region.

Final Finishing

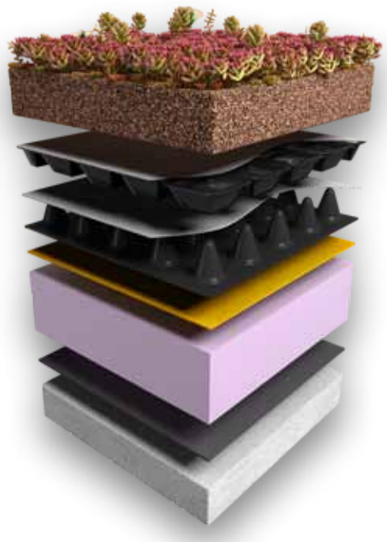
blueroof can be designed beneath all green roof types including extensive, intensive and biodiverse (brown). It is also suitable for use beneath paved or trafficked areas such as frequently used on podium decks. Suitable surfaces include permeable block paving, rubberised asphalt, ballasted etc. **blueroof** is also suitable for use with photovoltaic cells (PV).

The options are endless and comes down to the clients requirement for the final finish of the roof.

ABG Technical department are able to advise and assist with project specific design guidance to help meet the clients requirements.

Inverted Roof

In inverted roofs two layers of composite are used above the XPS insulation layer overlaid with a slimline separation membrane. In conjunction with a restrictor outlet chamber the two layers of composite provide a combined drainage and attenuation function across the roof area.



Podium Deck

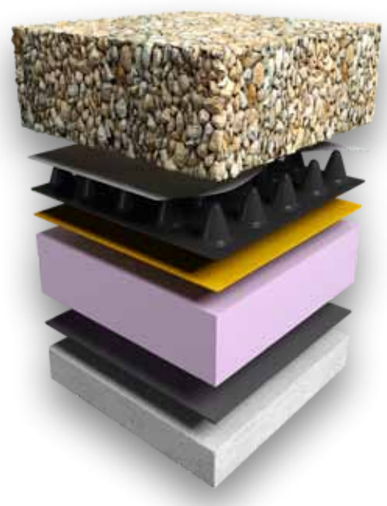
In podium deck construction typically the system utilises two layers of Deckdrain within the system. The upper layer forms a free flowing layer addressing drainage requirements during low flow whilst the layer beneath providing attenuation capacity during and after storm events.

Warm Roof

In warm roof construction the composites behave in much the same way as within the inverted roof construction with the whilst providing protection to the waterproofing system laid over the insulation.

Ballasted Roof

In ballasted roof construction the void within the ballast provides additional attenuation capacity therefore negating the requirement for a second layer of composite. The composite provides the main attenuation void across the roof area.



Roof Types

Like green roofs blue roofs are suitable for use on a wide range of substrates and are compatible with most modern waterproofing systems.

They are also flexible when it comes the roof build up being equally as effective on an uninsulated podium construction as they are within a warm or inverted roof construction

The illustrations on the left represent some of the more common roof build-ups with which the blueroof system can be used but they do not define its entire extent. The highly modular nature of the blueroof components mean that a system can be designed for most flat roofs and podium decks.

specific advice and guidance on individual project requirements is available through the ABG Technical Team who are happy to review your scheme and determine suitability.

SuDSpave

The SuDSpave system comprises complementary components that create an integrated porous paving system to effectively manage the safe collection, treatment, management and dispersal of surface water.

SuDSpave is configurable to individual project requirements and offers a range of surface solutions to meet the aesthetic and performance requirements. In addition, a range of geogrids and geocells can minimise construction depth whilst meeting the structural requirements. In addition high performance geotextiles help treat collected water to meet quality expectations. Finally geocomposites can allow the formation of a free storage void across the paved area to attenuate surface water during storm events.

Drainage

ABG drainage geocomposites offer high performance cost effective alternatives to traditional stone groundwater drainage solutions and have been used extensively in a wide range of civil engineering, environmental and building drainage applications.

Drainage geocomposites offer very high flow capacity, many times that of traditional crushed stone (specific data is available), this is achieved through the unique open structure created by the cuspated core construction which allows unhindered water flow through the system.

Geotextiles ensure that fines do not enter the flow void minimising the occurrence of blockages and allowing continuity of flow through the whole life of the installation

Webwall Retaining Walls

Webwall is a geosynthetic system designed for the construction of flexible retaining walls. It uses a geocellular mattress which is laid in layers with each expanded and filled with site won materials to form a structure with a vegetated face.

The Webwall system offers a solution in many SuDS applications with its primary use being in the construction of steep embankments on SuDS structures such as swales, channels and attenuation basins and ponds. Constructing steeper embankments minimises the land take of the structure freeing up more land for development.

As with all ABG systems a full design service is offered through our in-house team of chartered civil engineers.

Erosion control systems

ABG offer a broad range of erosion control products that includes biodegradable and non-biodegradable erosion control mats, They can help with the surface protection of many elements within the SuDS scheme including swales, channels, ponds and attenuation basins

Silt laden run-off from exposed soil slopes is a major concern for the Environment Agency who consider it a pollutant. Erosion control systems help to ensure the environment is protected throughout the life of the project from construction to establishment of the vegetation.

As with all ABG products design advice on which materials are appropriate for your specific requirement and their specification is available from our technical department.

About ABG

ABG is a market leader in the design, development, manufacture and technical support of high performance geosynthetic systems for use in a wide range of civil engineering, environmental and sustainable building projects.

Formed in 1988, based in Meltham, in the heart of the Pennines, ABG have developed an excellent reputation for developing quality products and delivering outstanding service. The ability for rapid product development ensures that the most innovative, up to date and cost effective solution can be found for many engineering problems.

ABG's involvement in roof drainage goes back over twenty five years and we have a complete range of products developed specifically for use in this technically demanding application.

Technical support is provided by our trained and experienced staff, many of whom are Chartered Civil Engineers. This extensive support extends to full design, design validation, feasibility studies, cost advice and advice on meeting regulatory requirements.

Part of this technical support includes developing and driving knowledge within our active markets including working with both international and local regulatory bodies on developing guidance and best practice in the use of innovative geosynthetics to solve complex engineering issues.

For further information or to discuss your project specific requirements contact ABG:

t 01484 852096
e blueroof@abgltd.com
www.abgltd.com

abg creative geosynthetic engineering

E7 Meltham Mills Rd
Meltham, Holmfirth
West Yorkshire, HD9 4DS
United Kingdom

UK Sales 01484 852096
Export 01484 852250
email technical@abgltd.com

www.abgltd.com

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