Sustainable Paving

A guide to the selection and specification of sustainable paving using ABG geosynthetic systems

abg creative geosynthetic engineering

The SuDSpave system offers a range of porous paving solutions to provide a particularly effective form of source control, managing flows and removing pollutants at the head of the management train and treating stormwater prior to it being safely discharged. SuDSpave attenuates water runoff during storms, minimising the risk of downstream flooding, whilst also providing a free source of water suitable for irrigation and other appropriate uses.

Sustainable Paving has a key role to play in achieving sustainable development and both BREEAM (Building Research Establishment's Environmental Assessment Method) and the Code for Sustainable Homes recognise the benefits of reducing the amount and rate of stormwater runoff and the effective treatment of pollutants.

It can also benefit biodiversity by providing unpolluted water for wildlife, plants and trees, whilst eliminating the hazards that traditional drainage systems, such as open gulleys and channels, present to wildlife,.

Within a BREEAM assessment, a credit is awarded where SuDS are used to limit runoff from a development and another where SuDS provide on-site treatment to minimise watercourse pollution. Credits are also available for the use of sustainable paving in providing beneficial impacts on local ecology. In addition, the use of porous paving to harvest rainwater for irrigation is also recognised with a credit, as is harvesting for toilet and urinal flushing. Similar provisions are included in the Code for Sustainable Homes.

SuDSpave can also manage runoff from roof drainage, as well as adjacent impermeable surfaces, and requires no additional land-take, making it efficient for high-density projects. It also provides a DDA compliant, safe surface negating puddles and ice formation.

With a range of surface options available including gravel, grass and precast concrete block paving, designers can select the appropriate finish to suit project specific aesthetic and performance requirements.

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Whilst a porous surface is the fundamental feature of any sustainable paving system, a hybrid approach also involving the use of traditional non-pervious paving can often deliver the optimum solution in terms of performance, buildability and cost. This approach is viable due to the hydraulic capacity of a porous pavement also being able to accommodate rainfall from other adjacent surface catchments – including roofs.

The combination of surface options also facilitates an enhanced level of flexibility and choice in satisfying the aesthetic requirements of the project.

The design and specification of the individual components within a sustainable paving solution is entirely project specific but will typically comprise a porous surface laid over an open-graded granular sub-base that satisfies the structural and hydraulic requirements of the project.

Geosynthetics play an important part in the design and long term performance of porous paving structures including the use of geotextiles as both filtration and separation layers. This greatly improves the quality of water discharged from within the system whilst also preventing clogging of the drainage system. Geogrids and geocells can also be incorporated to enhance the structural strength allowing the paving to be constructed thinner, safer and using less materials.

Also, the use of innovative geocomposite void formers to create cost-effective attenuation layers can further reduce the depth of stone required within the pavement construction.

Surfacing

A wide range of surfacing options are suitable for use in porous pavement systems including porous asphalt, concrete block paving, resin bound systems and paving grids such as SuDSpave CPG (illustrated here).

Aggregates

Aggregates provide the structural integrity of the system and require careful specification to ensure that water can flow through without adversely affecting the structural performance of the pavement.

When used as an infill for the SuDSpave CPG a smaller grading specification is required but the requirements regarding void space and fines content are equally applicable.

Further information on aggregate specifications is available from ABG Technical Department

Attenuation

The car park area can be used to provide storage for the collected rainwater until it is either infiltrated into the ground below or discharged to stormwater drains/watercourses.

There is a significant volume available of storage within the graded aggregate but often the site will require additional storage in the form of underground tanks, storage pipes or by utilising geocomposite void formers such as the SuDSbase system.

Vehicle loading

The structural strength of the materials should be adequate for the loads to which it will be subjected. The thickness of the CGA sub-base should be in accordance with BS 7533-13:2009, Pavements constructed with clay, natural stone or concrete pavers – Guide for the design of permeable pavements constructed with concrete paving blocks and flags, natural stone slabs and sets and clay pavers.

Reinforcement

Geocells and geogrids can strengthen the granular layer meaning that the pavement can be constructed thinner.

Using geocells on a sloping site provides the additional benefit of increasing the water storage capacity across the site by means of providing a baffle structure within the stone layer

Impermeable liner (option)

Where infiltration is not possible the use of an impermeable geomembrane liner helps manage the water into the drainage system whilst preventing loss into the underlying ground.

Structural Considerations

The sub-surface layers are a primary aspect of porous paving design and their specification needs to be carefully considered as they need to provide the structural element of the pavement whilst simultaneously transmitting or storing the collected water.

Coarse graded aggregate (CGA) sub-base layers should generally have a minimum porosity of 30% and be designed in accordance with BS7533-13:2009 which gives consideration to:

- Selection of an aggregate grading that offers a balance between pavement stiffness and attenuation capacity.
- Ensuring the durability of the aggregate when saturated and through the wetting and drying cycle.
- Specifying aggregates that are robust enough to survive the construction process.
- Locality of the materials to ensure they can be attenuation and produced and delivered to site.

Due to the relationship between the grading curve of the CGA sub-base and the laying course material, a geotextile may not be necessary from a structural perspective – however, it may be incorporated as one of the treatment stages in achieving the required level of Pollution Control.

Minimising the overall depth of pavement construction offers many environmental, safety and economic advantages. The use of geocellular confinement systems or geogrids within CGA sub-base layers is well documented and provides a cost-effective method of increasing structural stiffness to achieve a thinner pavement.

At the interface between the sub-base and subgrade, geotextiles also play an important role in delivering a structurally sound pavement construction acting as an efficient separation layer and preventing the migration of materials.

Hydraulic Considerations

There are a number of key considerations when designing porous pavements to ensure that the infiltration rate and attenuation capacity is sufficient for the specific development.

- To avoid surface ponding the infiltration rate of the surface needs to exceed the maximum rainfall intensity allowed for in the design.
- The attenuation capacity needs to exceed the volume of rainfall expected. Obviously the discharge rate needs to be taken into account as well as an allowance for water expansion as a result of freezing.
- The time for the system to empty to minimise the duration the aggregate is exposed to traffic loadings whilst saturated.
- The storm return period required by the local regulators.
- The likely consequences should flooding or ponding occur as a result of under capacity of the system.
- Steps should be taken to ensure that soil, sand and other particulate materials do not contaminate the surface during the construction phase.
- Surrounding landscaped areas should be designed to prevent run-off carrying soils and debris onto the pervious surface.

Sloping sites require special consideration as the surface gradient may result in a reduction in the storage capacity.

Pollution Control Considerations

The issue of pollution control is increasingly high on the agenda of the regulators and porous paving is generally recognised as the preferred method of source control within a sustainable drainage system.

Stormwater run-off typically contains a cocktail of hydrocarbon and heavy metal contaminants that need to controlled and treated with the minimum number of treatment stages required being dependent upon the potential hazards on the site and the sensitivity to pollution of the receiving water body.

More specifically, the use of geosynthetics within porous pavements makes a significant contribution to diffuse pollution control by achieving the required water quality at the point of discharge.

Geotextiles provide highly effective treatment through the safe entrapment and subsequent treatment of particulates and pollutants. It is important that the location and specification of the geotextile is carefully considered to optimise the rate of infiltration and treatment whilst minimising the risk of clogging within the system.

Geocomposites and geocells are increasingly being utilised to effectively manage pollutants and siltation within the system.

Maintenance Considerations

Routine maintenance is essential to ensure the effective through-life performance of any porous paving system.

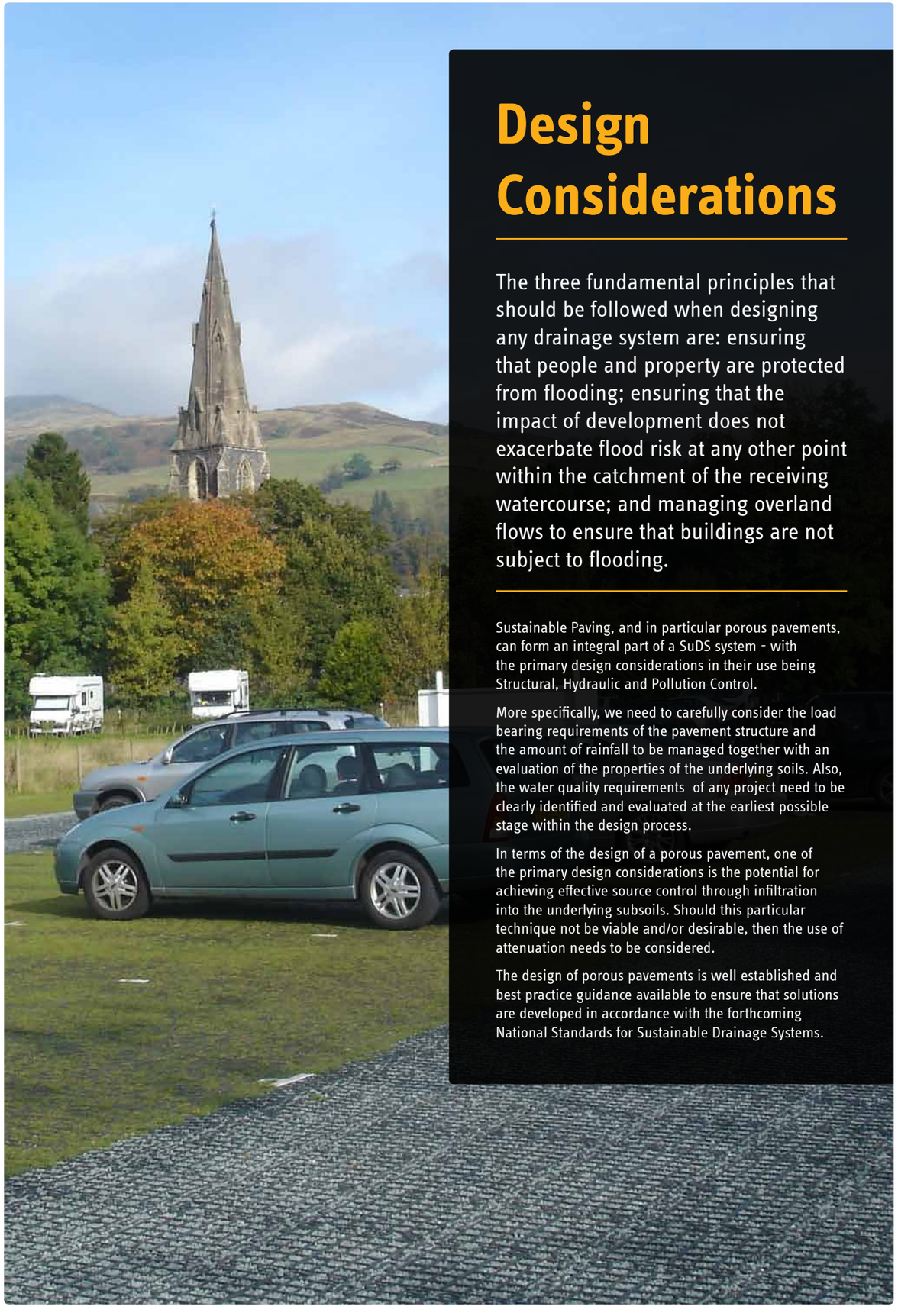
Cellular paving grid solutions infilled with gravel require minimal maintenance and turfed finishes can be mown with standard grass cutting machinery.

Due to the relatively small size and linear nature of the drainage apertures, permeable concrete block paving surfaces benefit from routine maintenance which typically comprises bi-annual vacuum-cleaning with commercial sweeping machines.

There are a number of factors that influence the type and frequency of the maintenance including:

- Type of use - frequently used surfaces require a more frequent maintenance regime than areas that are occasionally used.
- Is the paving public or private - public areas are more likely to require maintenance as elements such as litter accumulation are more likely to occur.
- Traffic loadings and speeds.
- Local environment - is the local environment existing or under construction.
- Proximity of landscaping - green landscaping local to the surface is likely to deposit debris that requires maintenance.

It should be remembered that materials removed from any surface during maintenance are likely to be contaminated with hydrocarbons or heavy metals and will need disposing of as controlled waste.



Design Considerations

The three fundamental principles that should be followed when designing any drainage system are: ensuring that people and property are protected from flooding; ensuring that the impact of development does not exacerbate flood risk at any other point within the catchment of the receiving watercourse; and managing overland flows to ensure that buildings are not subject to flooding.

Sustainable Paving, and in particular porous pavements, can form an integral part of a SuDS system - with the primary design considerations in their use being Structural, Hydraulic and Pollution Control.

More specifically, we need to carefully consider the load bearing requirements of the pavement structure and the amount of rainfall to be managed together with an evaluation of the properties of the underlying soils. Also, the water quality requirements of any project need to be clearly identified and evaluated at the earliest possible stage within the design process.

In terms of the design of a porous pavement, one of the primary design considerations is the potential for achieving effective source control through infiltration into the underlying subsoils. Should this particular technique not be viable and/or desirable, then the use of attenuation needs to be considered.

The design of porous pavements is well established and best practice guidance available to ensure that solutions are developed in accordance with the forthcoming National Standards for Sustainable Drainage Systems.

SuDSpave CPG

SuDSpave CPG is a flexible cellular porous paving system featuring a unique design that allows it to be laid either onto a constructed base or directly over existing hard surfaces.

Once installed, SuDSpave CPG forms a highly durable surface able to withstand the demands of vehicular traffic whilst meeting SuDS requirements by allowing the infiltration of rainwater.

SuDSpave CPG can be filled with either gravel or an appropriate growing media which is seeded to create a choice of aesthetically pleasing natural surface finishes.

As a fully constructed system, SuDSpave CPG provides a permanent solution for a wide range of applications including car parking areas, emergency vehicle access routes, cycle paths and pedestrian walkways. The system is widely used on large commercial projects but is equally suitable for single domestic applications.

When filled with decorative gravel the structural cells in the units create an attractive and hard wearing surface which eliminates the problem of rutting caused by gravel migration.

Alternatively the cells can be filled with soil and then seeded to produce a structurally reinforced natural grass surface solution.

SuDSpave CPG is manufactured in the UK and is delivered to site pre-assembled as four units covering approximately one square metre.

SuDSpave CPG Infilled with Gravel

Infilled with gravel SuDSpave CPG provides a durable long-term solution for areas where porous paving is required and other solutions do not meet the aesthetic requirements of the project.

It is essential that the correct stone infill is specified for the infill so that structural integrity is maintained without compaction occurring that may impede the infiltration of surface water into the paving structure.

SuDSpave CPG with grass

SuDSpave CPG planted with grass provides an ideal solution where occasional access is required such as temporary parking areas or fire access roads.

One the grass is established the paving grid virtually disappears leaving a green surface with the strength to carry vehicular traffic.

Key to its success is selecting a suitable growing media that provides the correct environment for supporting grass growth whilst maintaining an open void structure to allow free infiltration of surface water.

Features and Benefits

- Flexible porous paving system suitable for a wide range of applications
- Natural gravel and grass surface infill options
- Modular clip together system for simple and rapid installation
- Manufactured in the UK from recycled HDPE/LDPE
- Can be installed on top of existing surfaces as a no-dig solution
- Designed to withstand occasional HGV trafficking
- Demarcation inserts available for car parking and access route

Material specification

		CPG440
Unit dimensions	mm	495 x 495 x 40 deep
Panel weight	Kg/m²	6.4
Load bearing capacity	tonnes/m²	360
Material		recycled HDPE/LDPE

The information above is for guidance only and should not be taken as guide for design. Site specific design guidance and data sheets are available through the ABG Technical Department on 01484 852096 or by emailing technical@abgltd.com.

SuDSweb

SuDSweb is a three dimensional geocell system designed specifically for use within sustainable paving solutions. It can be utilised as a surfacing element in its own right or as strengthening element within sub-surface granular layers.

SuDSweb can provide a cost effective porous surfacing option where natural gravel is the desired finish. In this application, the confining benefits of the SuDSweb system facilitates a reduced depth of construction whilst also negating the potential for gravel migration. The enhanced flexibility of the system also enables existing site contours to be followed minimising cut and fill operations.

The structural benefits of cellular confinement within granular layers is well known with a successful track record of use of more than 30 years. It is particularly beneficial for load distribution over weak soils.

In load support applications such as porous pavements, the geocell structure stabilises the infill material and controls shearing, lateral and vertical movement. When incorporated within granular sub-base layers, the use of SuDSweb allows a significant reduction in the overall depth of pavement construction and also provides the potential use of less costly materials.

On sloping sites, SuDSweb can also be utilised to effectively manage the lateral flow of sub-surface stormwater by acting as a series of baffles to attenuate the flow and assist in compliance with limited discharge consents.

SuDSweb used as reinforced surfacing solution

Infilled with gravel SuDSweb forms an effective surfacing reinforcement option for areas with traffic.

Selection of the correct fill is crucial to its longevity along with an geotextile appropriate to the underlying soil conditions. The geocell structure should be overfilled to prevent damage occurring to the upper surface of the web structure.

SuDSweb as a reinforcing layer

Incorporated within the stone sub-base SuDSweb offer a highly effective reinforcement layer that can greatly reduce the depth of stone required (up to 50% depending on site conditions) within the pavement structure.

On sloping sites where the stone sub-base is also acting as an attenuation layer the inclusion of the web structure creates a series of baffles across the site which greatly increases the water storage capacity. Effectively each cell within the structure acts as a small reservoir

SuDSweb 200/300

Material		High density polyethylene (HDPE)
Depth	mm	200
Cell diameter (nominal)	mm	300
Wall thickness	mm	1.2
Seam tensile strength	N	2400
Wall Perforations		Yes, if required
UV stability		Excellent
Chemical resistance		Excellent
Life expectancy	Years	120
Dimensions		
Panel length	m	6
Panel width	m	4
Supply		Collapsed to 9m x 0.1m x 0.2m concertina folded and packed on pallets
Ancillaries		
Fixing pins	mm	500 x 1.2 ∅

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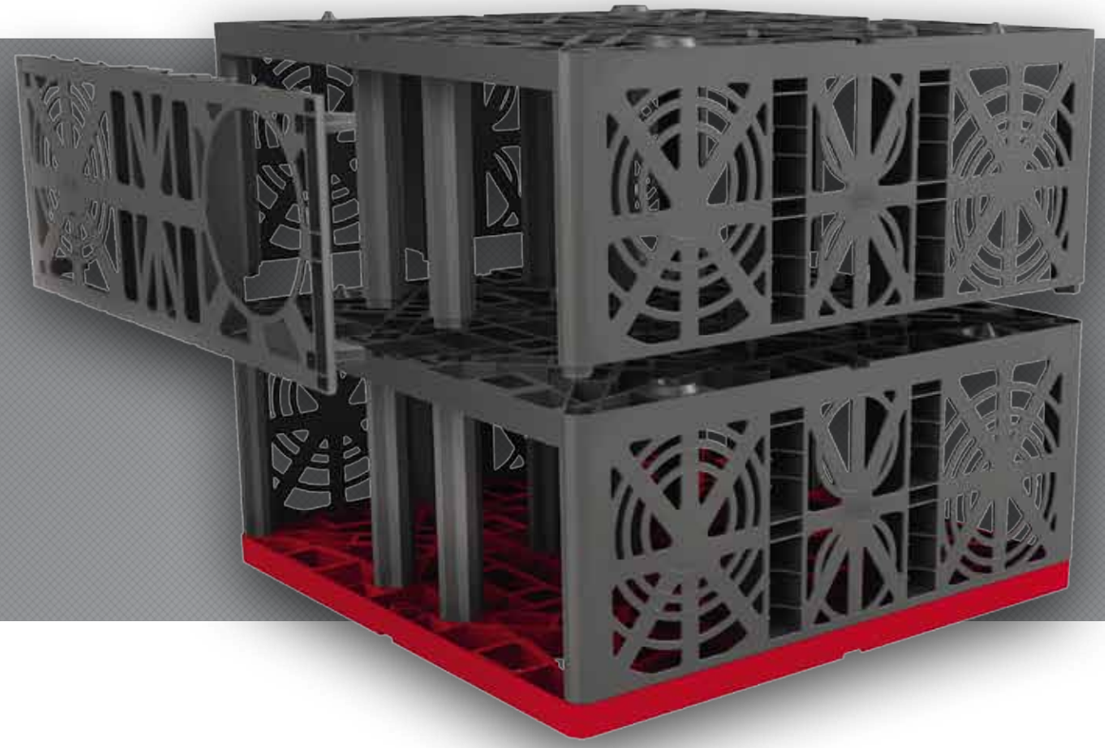
EcoBloc flex

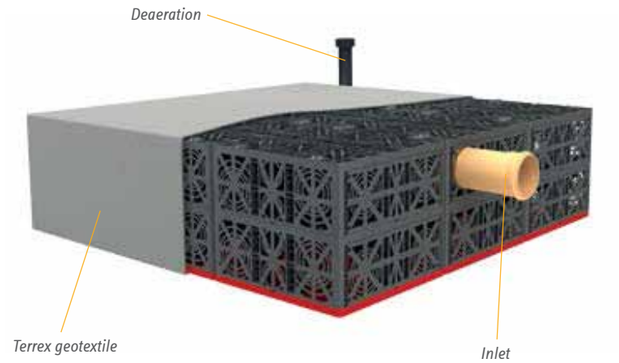
EcoBloc flex is a cellular system designed to form underground voids allowing the infiltration, detention, retention or harvesting of rainwater collected as part of SuDS scheme. The modular concept allows the system size and bearing capacity to be tailored to suit site specific requirements in both trafficked and non-trafficked areas.

Designed correctly EcoBloc flex has the capacity for a heavy-duty lorry bearing capacity of up to 60 tons with as little as 800mm earth covering. Even under very heavy loads the EcoBloc flex system can be installed at a depth of up to 5 metres, this means that up to 14 layers are possible.

EcoBloc flex modules are easy to both transport and install. To save space during transport, two modules are stacked one inside the other halving transport costs and reducing CO_2 emissions. The lightweight units are easy to handle on site and the modular system structure requires few accessories and no specialist tools for installation.

The EcoBloc flex system allows easy access for inspection and monitoring and during routine maintenance is robust enough to resist high pressure jetting.



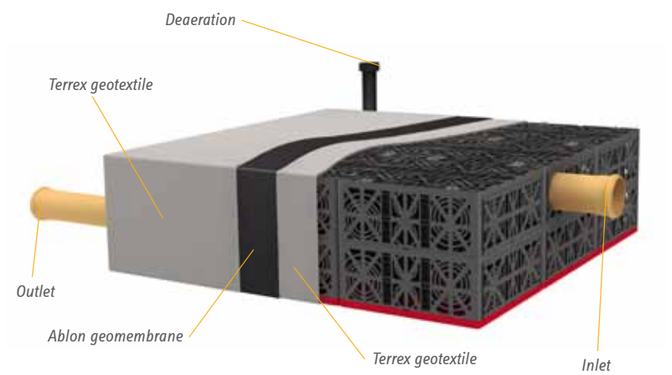


Infiltration

Infiltration is the preferred method of source control and should be utilised whenever possible. The modular EcoBloc flex system, encapsulated with an appropriate geotextile, facilitates a high degree of flexibility in design and can be used for the creation of a wide range of infiltration solutions of various configurations from linear infiltration trenches to large footprint underground structures.

Attenuation

When encapsulated with an appropriate geomembrane with geotextile protection, the EcoBloc system provides an economic attenuation tank solution for the safe storage of stormwater prior to its controlled discharge or re-use. Where attenuation is being utilised in brownfield site applications or the catchment is above a groundwater protection zone, the specification of the geomembrane/ geotextile material is critical to ensure the long term performance of the system.



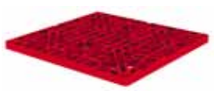
Installation criteria

		Without traffic load	Vehicle	Truck 12	Truck 30	Truck 40	Truck 60
Min. earth covering	mm	250	250	500	500	500	800
Max. earth covering	mm	2750	2750	2750	2500	2250	2000
Max. installation depth	mm	5000	5000	5000	5000	5000	5000
Max. number of layers	Nº	14	14	13	13	13	13

EcoBloc flex

Weight	kg	8
Gross volume	l	205
Net volume	l	195
Storage coefficient	%	96

EcoBloc flex baseplate



Weight	kg	4
Gross volume	l	25
Net volume	l	20
Storage coefficient	%	95

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Green and Blue Roofs

ABG green and blue roofs (constructions that have the ability to attenuate collected water within the roof/podium deck structure) have been used extensively across many leading sustainable developments across the UK. Offered as full turnkey solution including PI covered design through to installation and on-going maintenance they provide an integral element of any holistic SuDS solution.

As with SuDSpave the final design of the system is dependent on the project specific requirements with a number of final surface finishes available including extensive, intensive and biodiverse vegetation along with paved finishes.

The drainage/storage capacity is also project specific to meet the requirements of the SuDS design.

Erosion Control

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 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 best for your specific requirement and their specification is available from the in-house technical department.

Drainage Systems

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 construction which allows unhindered water flow through the core.

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

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.

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 applications within the built environment.

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 sustainable construction problems.

ABG's involvement in sustainable drainage systems goes back over twenty five years with the development of innovative drainage products that directly replace the requirement for stone. We have wide engineering expertise coupled with a complete range of geosynthetic 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.

A full installation and maintenance service for many ABG systems is available through our in-house installation business, Geogreen solutions.

t 01484 852096 **| e** SuDS@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