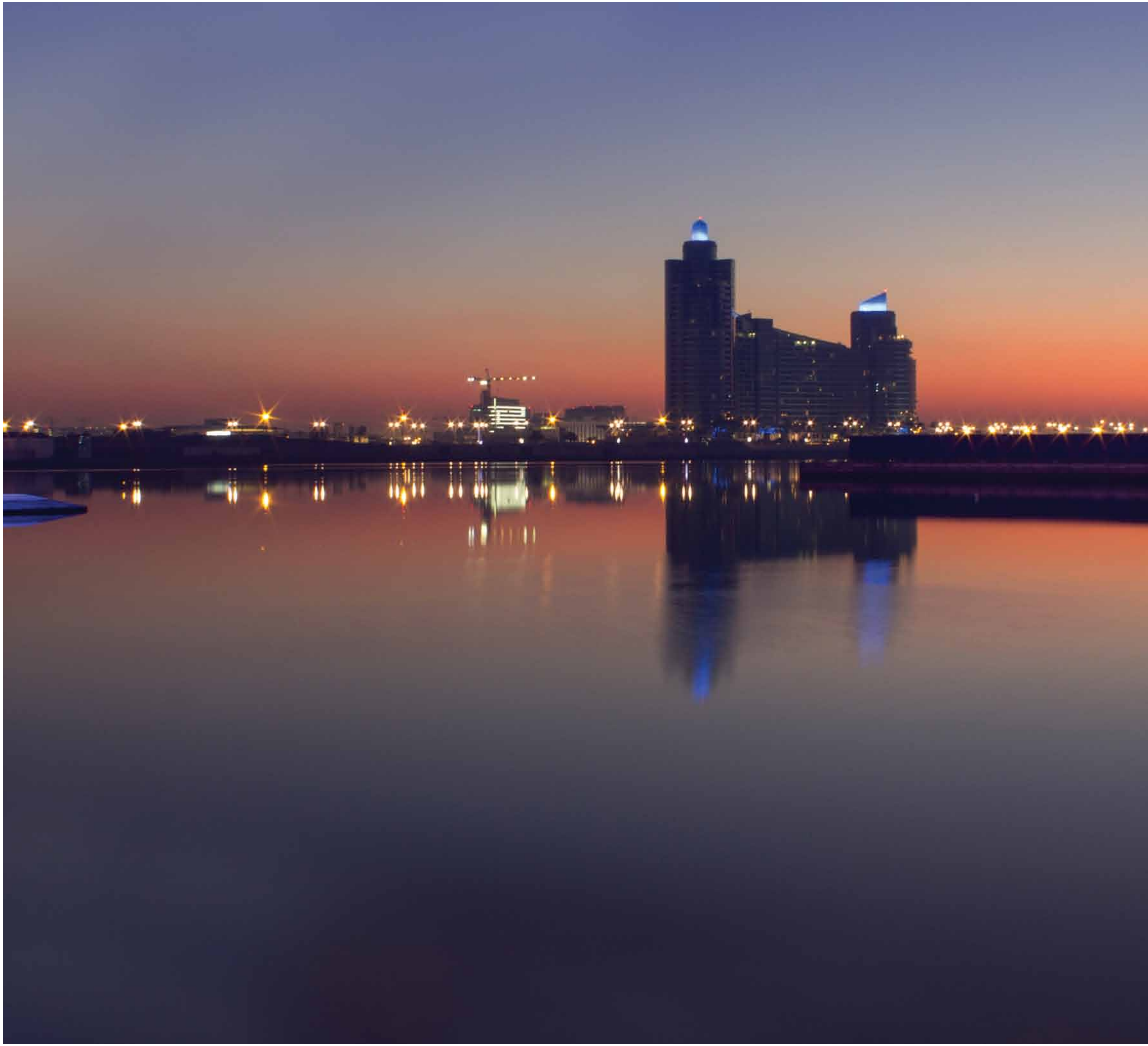
Break Layers

A guide to the design and specification of capillary break, salt barrier and frost barrier layers.

abg creative geosynthetic engineering



Upward movement of water in fine grained soil is a natural process that is usually beneficial but presents problems when the water is saline, contaminated or if the water is clean but the ground is liable to freezing.

The water is sucked up by the soil through very small pores within the soil called capillaries. The extent of the capillary rise above the water table can range from 200mm to several metres depending upon the type of soil.

If saline water comes into contact with plant roots, the plants will most probably die. If contaminated water is drawn up into clean ground that is cultivated, then not only plants but humans and animals are at risk. If clean water is drawn up into ground that freeze/thaws, ice lenses will form that will displace the ground surface and subsequently cause collapse of the surface when the ice melts.

Measures must be taken to prevent the upward capillary rise from reaching the clean soil. This is achieved by creating a void above the water table across which moisture cannot rise. The void does not need to be large but it does need to be robust. Traditionally a thick layer of coarsely graded stone was used. The large thickness being required to combat the stone to stone contact within the layer that could potentially allow some moisture to rise.

It is now more common to use a geocomposite void forming layer. The geocomposite capillary break is a thin layer which forms a void across which the moisture cannot pass. The geocomposite has adequate in-plane flow capacity to drain sub-surface water from above and substantial compressive strength for the long-term loading.

Use of the geocomposite results in less excavation, less transport of bulky materials to site and thereby a reduced carbon impact of the project.

Contents

Pozibreak

Pozibreak is designed specifically as a drainage void layer to protect the ground above from the capillary rise of moisture from the ground below.

A cuspated core is used because it is essential that the void is maintained and that the upper and lower geotextiles cannot touch each other under the action of the soil pressure. Similarly, unless the core is impermeable one side, it is essential that the core does not become totally saturated and therefore that the core has a very high lateral in-plane flow capacity in multiple directions.

There are two forms of Pozibreak:

Unperforated.

An unperforated cuspate core with a geotextile laminated to the upper side.

Perforated.

A perforated cuspate core with geotextile above laminated to the upper and lower sides.

Unperforated

Comprising a single-cuspated core with good long term compressive strength, a practically impermeable lower side and a very high in-plane multi-directional flow capacity, laminated to a non-woven geotextile. The geotextile allows clean sub-surface water to freely enter the core but prevents intrusion of the soil into the core. The core provides the void by the excellent support given to the geotextile and transmits the clean water horizontally to collection pipes.

The practically impermeable lower side of the core provides a barrier to the capillary water for added protection in addition to the void. This is a particularly useful feature when saline or contaminated water cannot be allowed to mix with the clean water.

The impermeable core means that saturation of the core void at local low spots can be permitted without risk of breaching the integrity of the barrier.

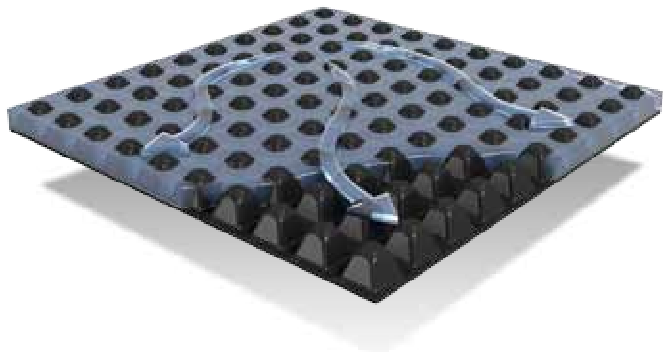
Perforated

Comprising a perforated single-cuspated core with good long term compressive strength and a very high in-plane multidirectional flow capacity, laminated to non-woven geotextiles on both sides. The geotextile allows water to freely enter the core but prevents intrusion of the soil into the core. The core provides the void by giving excellent support to the geotextile and creates a path for excess water to flow horizontally. The perforations allow the clean water to exit through the lower side of the core into the ground below but this relies on the ground having adequate permeability. The flat area of the core discourages the capillary moisture from entering the core.

The in-plane flow capacity of the core must be designed to remove all of the expected sub-surface water entry from the overlying soil without the core becoming saturated at the site designed specific gradient and outfall/collector spacing.

The non-woven geotextiles have been selected for compatibility with a wide range of soils but ABG will perform site specific designs when requested. The upper geotextile is hydrophilic with zero break through head which means that water will pass without resistance. This is particularly important when the over lying soil layer is relatively thin.

Pozibreak is installed above the water table and can be installed quickly and easily without specialist equipment and with simple training for the installation team.



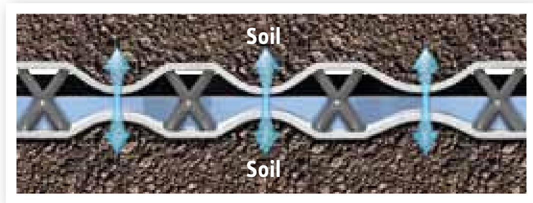


Fig. a. Utilising Geonet

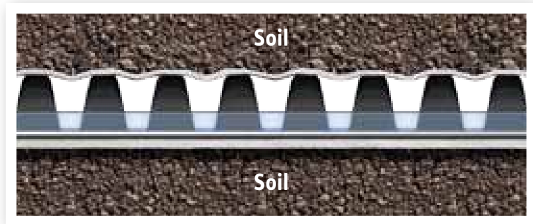


Fig. b. Utilising Pozibreak

Multi-directional flow

Crushed stone has equal flow in all directions. For true equivalency, the geosynthetic must also have multi-directional flow because installation is often at multi-directional gradients.

Pozibreak has true multi-directional flow. Many other geocomposites including geonets do not.

Soil Intrusion

When the geocompsite is installed within the ground, the soil exerts pressure on the geotextile surface of the geocomposite. If the geotextile yields and intrudes into the core of the composite, the performance is compromised. **fig. a.** This can be assessed visually and by the test standard ISO12958 using SOFT PLATENS boundary conditions. Pozibreak has excellent resistance to geotextile intrusion. **fig. b.** Many other geocomposites do not.

Salt Barrier

In deserts and arid regions, the groundwater is often saline and the water table can be relatively close to the surface. The capillary rise above the water table brings dissolved salts near to the surface of the ground. This results in severe problems for vegetation and the foundations of building structures.

Landscaping within modern developments in arid regions is particularly at risk. Most vegetation is intolerant of even slightly saline water (3-6 g/litre). Saline moisture must be prevented from reaching the root system of the vegetation. Similarly, it is important that irrigation water has minimal salt content to minimise the risk of salination of the soil (<0.5 g/litre no risk; 0.5-2g/litre moderate risk). For vegetation to survive, it is essential that there is a barrier between the saline ground and the clean ground and that this barrier also provides good drainage.

Building foundations of stone and reinforced concrete are designed for long term strength but this is compromised when saline moisture attacks the concrete. Chloride ions within saline moisture are drawn into stone and concrete where the resultant chemical reaction causes expansion, spalling and weakening of the foundations. It is important that there is a barrier between saline ground and clean ground in which foundations are constructed.

An effective barrier is to provide a capillary break layer between saline ground and clean ground. The capillary break layer creates a void across which capillary rise of saline moisture is prevented. It is essential that the capillary break layer is installed above the highest level of the water table so that the void is never totally saturated by ground water and that the capillary break has high in-plane flow capacity so as to remove sub-surface and irrigation water that enters through the clean ground above.

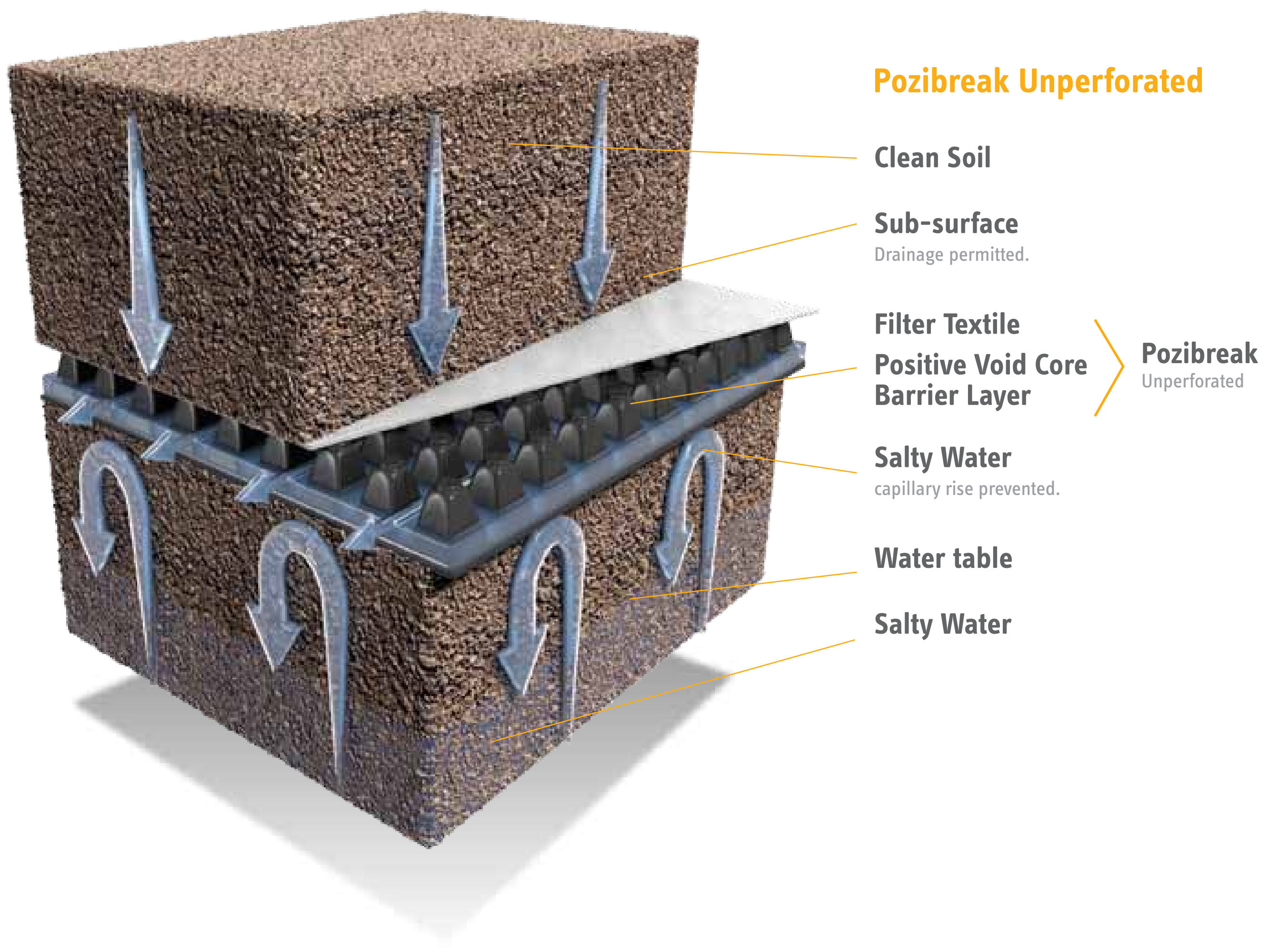
High performance geocomposites, such as Pozibreak, are the preferred choice for the salt barrier capillary break layer. This is because the cuspated core maintains an open void with its high compressive strength and excellent support to the geotextile surfaces under the action of soil pressure as tested to ISO 12958 with SOFT PLATENS. Performance is further enhanced in Pozibreak Unperforated, where the lower side of the cuspated core provides a practically impermeable barrier to the rising saline moisture.

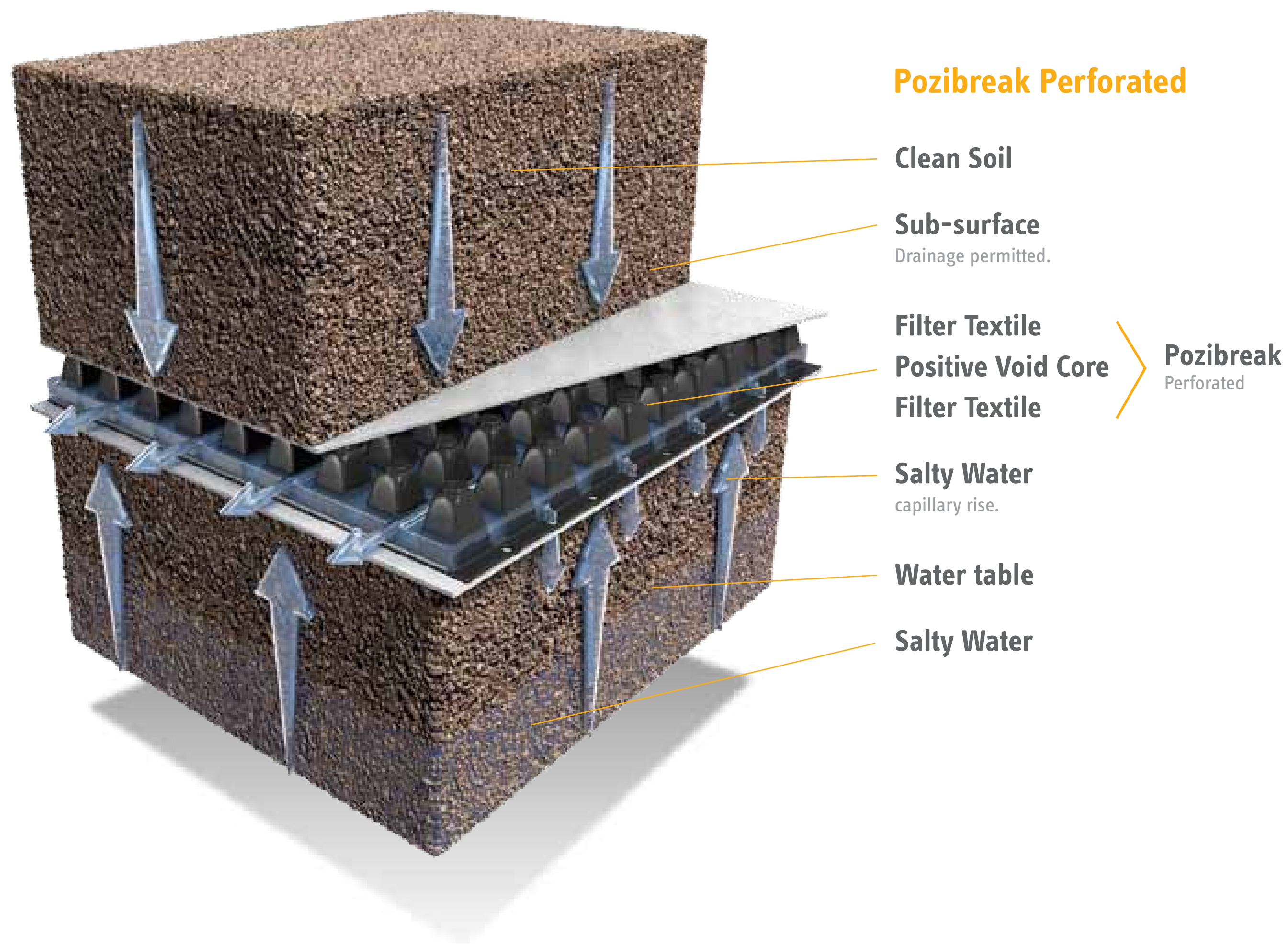
The capillary break layer is typically laid at a shallow gradient (eg. 3%) and the in-plane flow capacity will be significantly lower than at a hydraulic gradient (HG) of 1 (ie. vertical). The volume of irrigation water coming down through the soil above will be governed either by the irrigation rate or by the permeability of the soil.

If the soil permeability is 1 x 10^{-6} m/s this equates to a water volume of 1 x 10^{-3} l/m²·s

In a 100m length of salt barrier this creates a flow of 0.1 l/m·s. A Pozibreak 7 with a flow capacity (MD+CMD) of 2.4 l/m·s at HG1 and 20kPa soil pressure has a flow capacity of 0.35 l/m·s at HG 0.03 and 20 kPa to ISO 12958 with soft platens.

The Pozibreak salt barrier should not reach full saturation so take 30% of its maximum capacity. That gives 0.11 l/m·s and the Pozibreak 7 is satisfactory. If the soil permeability is 1 x 10^{-5} m/s then there would be 10 times more water from the soil (if the irrigation rate allows) and therefore Pozibreak 7 would allow only a 10 metre maximum length of salt barrier; alternatively use Pozibreak 25 with a flow capacity of 2.1 l/m·s at HG 0.03 for the 100m length.





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, highway, structures, environmental and 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 geocomposites goes back over twenty five years and we now have the most comprehensive range of products developed specifically for use in this sector. During this period ABG has supplied major projects in the UK and worldwide.

Technical support on ABG systems 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.

Other products available for use in landscaping applications include:

Webwall – vegetated green retaining wall utilising local soil fill

Erosaweb – soil slope stabilisation

Trigrid – geogrid with protective coating

Green Roof – vegetated roof system for climate control.

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