ABG Deckdrain vs. Filter Stone

A technical comparison of drainage performance

Technical Note

Introduction

A drainage zone is provided to the rear of the bridge abutments, basement walls, and retaining walls to prevent the build-up of hydrostatic forces. Traditionally, this consists of a 300-600mm layer of no fines stone and a geotextile filter to prevent fines intruding into the stone. This note addresses the drainage performance of this traditional method and compares it to the performance of **ABG Deckdrain.**

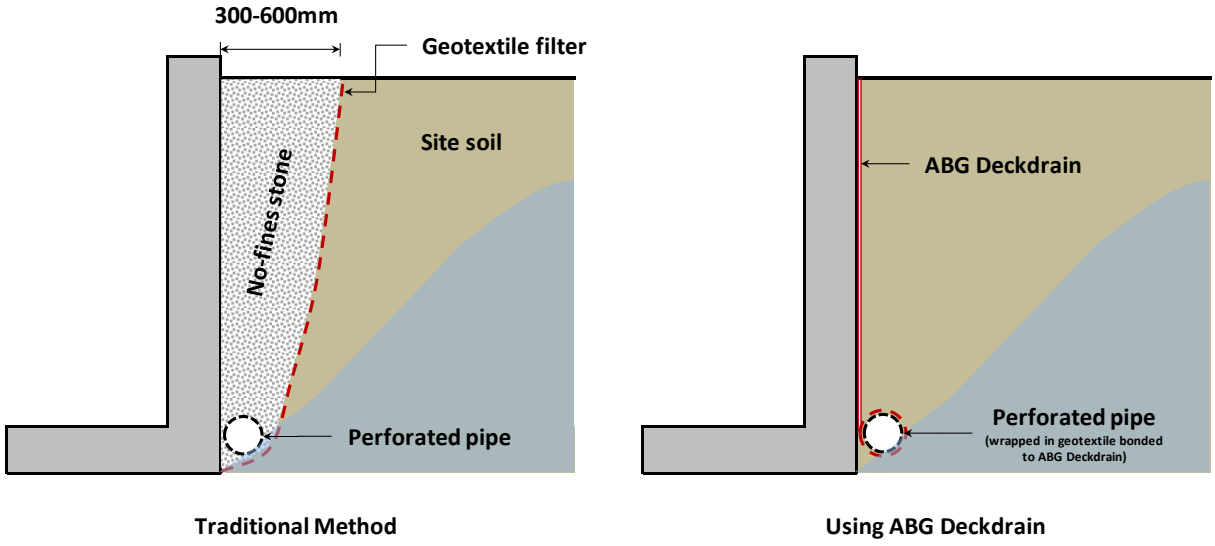

Figure 1: Drainage zones behind buried structures

Background

The practical difficulties and cost of placing granular filter/drainage material behind walls and abutments are well known. Recognition of the inadequacies of the traditional methods, and the increasing use of geotextiles as filters in road drainage, led to the development of drainage geocomposites. These consist of a cuspated HDPE core bonded to a geotextile filter. They have been developed specifically for drainage of structures and possess the necessary technical properties – compressive strength, permeability, and pore size – for long term performance. In most cases geocomposites outperform all granular solutions and specialised manufacturers such as ABG, with well-established experience, will certify the durability of the product for the 120 year life of the project.

Deckdrain Geocomposite

ABG Deckdrain consists of a polyethylene (HDPE) core which is cuspated on one side with a geotextile thermally bonded to the cuspates. The cuspated side faces the soil, the geotextile acts as a filter to prevent fine particles from washing out and the HDPE core allows for optimum water flow. The HDPE gives **ABG Deckdrain** a high compressive strength, is stable in all regular soil conditions, is rot proof with a long life, and has a wide working temperature. The spacing between the dimples on the cuspated side is matched to the strength of the geotextile to ensure that the backfill cannot intrude into the core and block the water flow. The non-cuspated side of **ABG Deckdrain** is relatively flat to protect structural waterproofing, where present.

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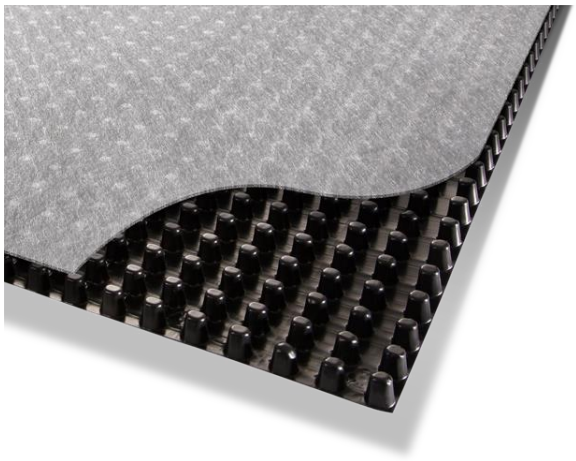

Figure 2: ABG Deckdrain

The geotextile used can be matched to the soil particle size grading and permeability. The standard geotextile used has a pore size of 120 microns and permeability of 100 l/m·s. This is compatible with all regular soil conditions. **ABG Deckdrain** is also available with special textiles of very small pore size for use with PFA and other challenging soils, and in a range of higher strengths and flow capacities for exceptionally demanding situations. Our technical department would be pleased to advise on appropriate geotextile selection.

Technical Note

Granular Filter Flow Capacity Assessment

Using Darcy's Law for the movement of water, the flow capacity through a granular material is given by:

$$Q = k \cdot i \cdot A$$

Where Q = Water flow (l/s)
k = Permeability (m/s)
i = Hydraulic gradient (decimal)
A = Cross sectional area of flow (mm x m)

Considering a 1 metre strip of filter stone at hydraulic gradient of 1 (vertical flow):

The vertical flow capacity

$$Q = k \cdot 1 \cdot (w \cdot 1)$$

$$= k \cdot t \ \text{l/m·s} \ \text{(l/s per m width)}$$

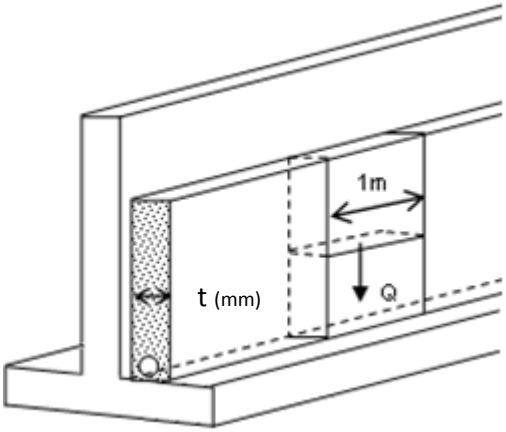

Figure 3: Granular drainage zone layout

The specified permeability of filter stone can vary from 10^{-2}m/s to 10^{-4}m/s (860m/day to 8.6m/day). So the drainage capacity for a typical 600mm wide granular filter can vary from 6.00 l/m·s to 0.06 l/m·s.

Geocomposite Flow Capacity Assessment

ABG Deckdrain comes in several different thicknesses in order to provide a range of different drainage rates. From 'In-plane' flow testing in accordance with EN ISO 12958, the mean vertical flow capacity at various compressive stresses is shown below. These 'in-plane' flow values have been obtained with soft platens to simulate real soil conditions. This is important as flow results obtained using hard platens will not model the intrusion of soil into the core and give incorrect higher flow rates. This difference is illustrated in Figure 4.

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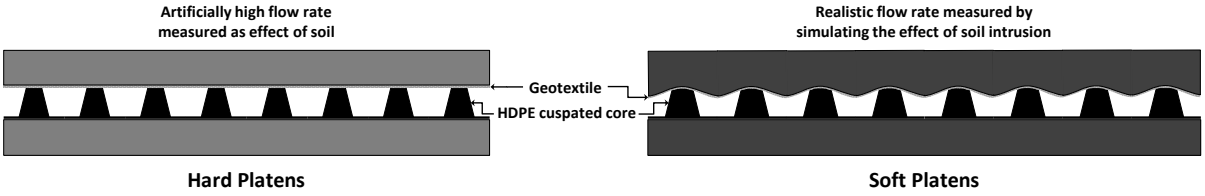

Figure 4: 'In-plane' Flow Testing in accordance with EN ISO 12958

Table 1: ABG Deckdrain Vertical Flow Capacities (l/m·s)

	4S250	6S250	7S250	12S250
20kPa	0.85	1.45	2.40	4.25
100kPa	0.75	1.35	1.95	3.20
200kPa	0.60	1.10	1.45	1.80

The grades of **ABG Deckdrain** shown above are standard sizes and strengths with many other variations available. They contain HDPE cores of nominal thicknesses of 4mm (4S250) to 12mm (12S250).

The horizontal soil pressure behind a wall varies with depth approximately as indicated below. Hence the 'in-plane' flow testing has been conducted at a range of pressures to determine the variation in flow capacity.

Table 2: Approximate Horizontal Soil Pressures at Depth

Depth (m)	2	5	10	15
Pressure (kPa)	20	50	100	150

As with all materials, plastics compress under load. They also creep, that is they continue to compress under constant load up to a limit. This is referred to as long term creep compression. For standard grade **ABG Deckdrain** at the pressures in Table 2 the long term creep compression is less than 25%. Higher strength cores are available which can limit creep compression to less than 13% at pressures up to 1,000kPa.

Flow Capacity Comparison

As demonstrated in above, the flow capacity of a granular filter depends on the thickness of the layer and the permeability of the stone used. For a geocomposite filter such as **ABG Deckdrain**, the dimensions, strength and stiffness properties, and the horizontal soil pressure are the governing properties. Shown in Figure 5 is a graph of granular filter thickness vs. flow for various granular filter permeability grades. Superimposed on this graph are the flow capacity ranges for **ABG Deckdrain** at different pressures (higher flow capacities are available at lower pressures).

Conclusion

ABG Deckdrain provides flow capacity equivalent to that of granular filters with just a fraction of the space required. This allows greater use of onsite materials, reduces the need to acquire suitable granular filter material, and comes pre-installed with a geotextile filter. On sites where suitable granular filter stone is not readily available this can lead to significant savings both in terms of cost and CO_2 emissions.

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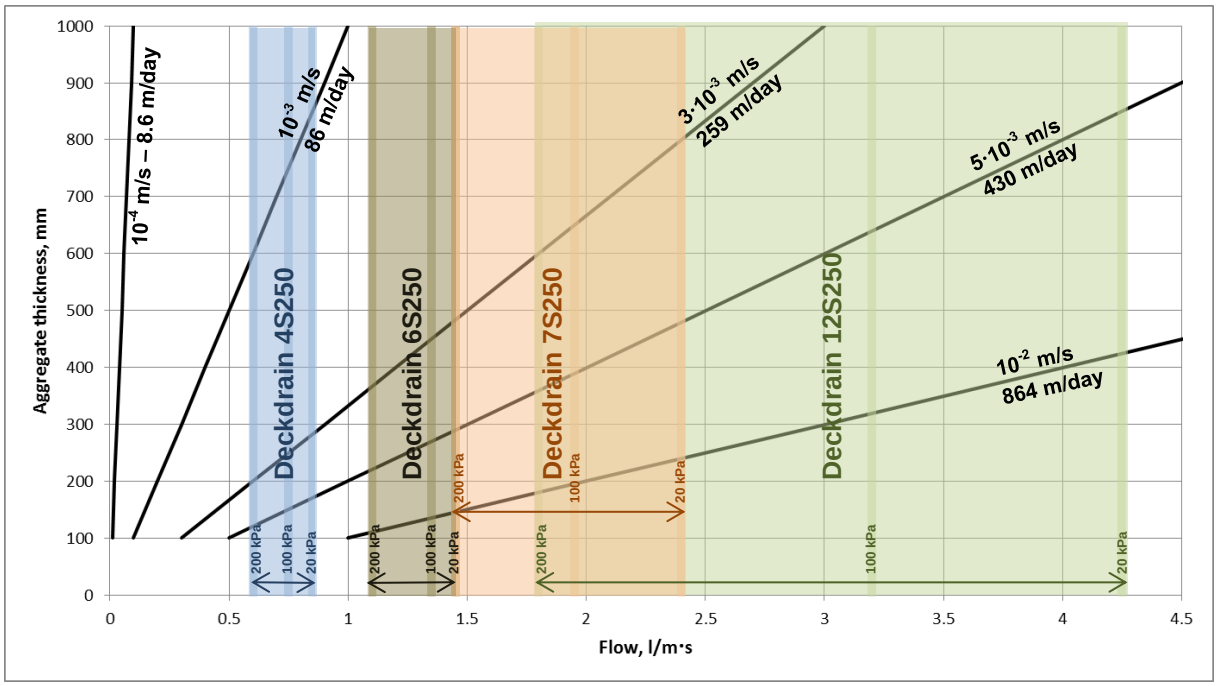
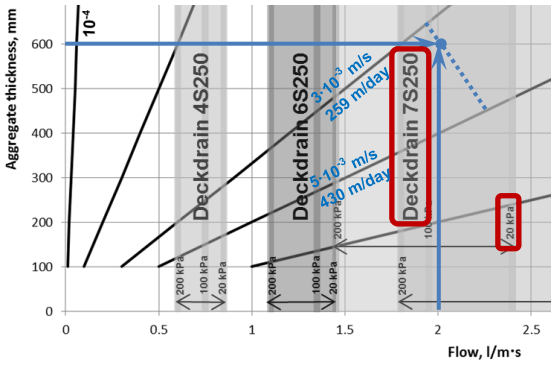


Figure 5: Vertical Flow Capacity Equivalence

Example Assessments

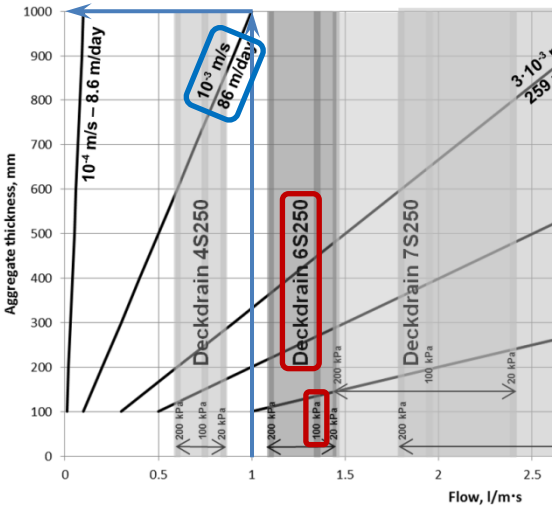
Example 1

Consider a retaining wall which is 2.0m tall and needs to be able to manage a very high maximum groundwater flows of up to 2.0 l/m·s (175 m^3/m·day). If you were to use a traditional granular filter of 600mm thickness you would need a granular material with a permeability of approximately $3.5 \cdot 10^{-3}$ m/s (or 300m/day). As the wall is 2.0m tall, the approximate maximum pressure is 20kPa. As noted, Deckdrain 7S250 will be easily able to manage these flow levels.



Example 2

Another example may be where you have a 10m deep basement excavation and a nearby source of aggregate with a permeability of 10^{-3} m/s (86 m/day). The required maximum flow is 1.0 l/m·s. To manage these flows with a granular filter you would need a 1000mm thickness of aggregate. As the basement is 10m deep the approximate maximum pressure is 100kPa. In this situation Deckdrain 6S250 will easily be able to manage these flows.



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