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PermCalc

PERMEABLE PAVEMENT DESIGN SUGGESTION

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Region: England

DATE: 5 Jun 2020 01:32 PM



Notes:- V6 is the initial design for the permeable area. Uses HBCGA as the roadbase and assumed a CBR of 5% for design purposes with Category over run 4 for 10 HGV's per week. Return 1-100 with climate at +30%, flow rate 8.91 l/s/site (2790m²) with 700m² of permeable and no roof water equates to 31.9 l/s/ha. Length of pavement 80m with change in height of 2m

This design suggestion is given on the basis that the recipient has read, understood and accepts the disclaimer at the end of this document.

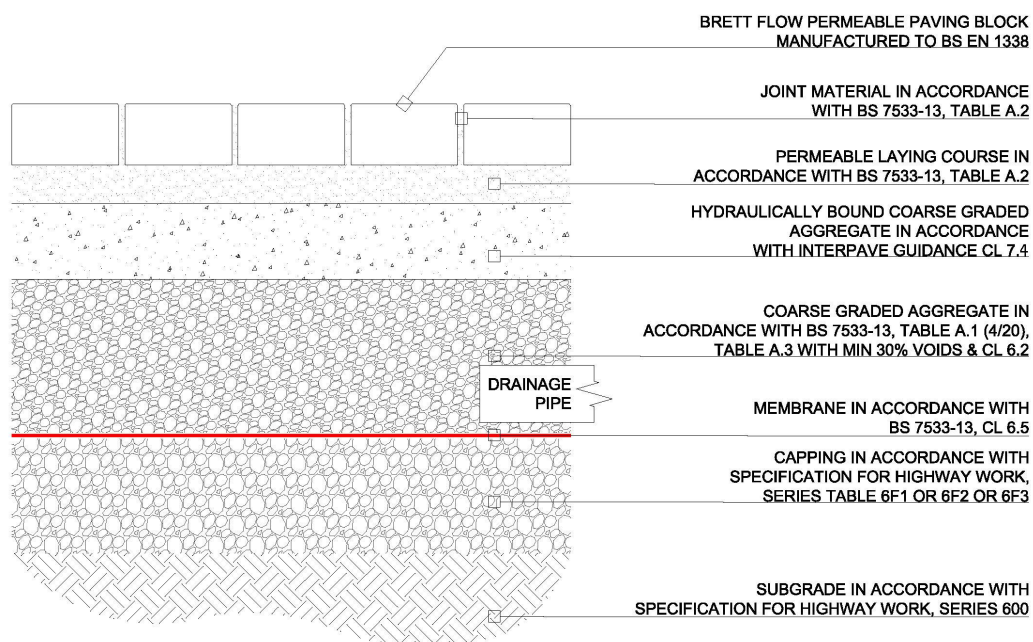
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Registered Office: 150 Aldersgate Street, London, EC1A 4AB
Brett Landscaping and Building Products is a trading name of Brett Landscaping Limited
Registered Company No: 227266

Suggested Pavement Solution

Permeable Pavement Design Suggestion

Omega Flow	80mm
Laying Course	50mm
Hydraulically Bound Coarse Graded Aggregate	150mm
Coarse Graded Aggregate	150mm
Membrane	Yes
Capping	150mm

System C with HBM and Capping Layer



*INTERPAVE GUIDANCE 'PERMEABLE PAVEMENTS GUIDE TO THE DESIGN, CONSTRUCTION AND MAINTENANCE OF CONCRETE BLOCK PERMEABLE PAVEMENTS' EDITION 6

Summary of pavement requirements

Depth needed for Structural design (excluding capping)	300mm
Depth needed for hydraulic design	290mm
Is there spare hydraulic capacity	Yes
Spare hydraulic depth	10mm
Additional catchment area to fully utilise spare hydraulic storage capacity	0m ²
Slope	1.43°
Internal dams	Yes
Distance between internal dams	10.2m.

Summary of hydraulic requirements

Available hydraulic storage	63,000 litres
Hydraulic storage require	59,470 litres
Spare hydraulic storage	3,530 litres
Half empty time	1.85 hours

Notes

To achieve a run-off rate of 31.9 l/s/ha at 1 number outlet the orifice plate must be 28mm.

A sloping pavement will have a reduced pavement hydraulic storage capacity. In these situations PermCalc checks that there is sufficient hydraulic storage capacity utilising the design depth of the pavement. If there is still insufficient storage capacity, PermCalc will introduced internal dams equi-spaced along the length of the pavement to create smaller compartments to create sufficient hydraulic storage economically

Note: The flow will need to be restricted between each compartment, or alternatively the water stored in each compartment can be piped to the next stage of the management train or drainage system. Separate calculations will be needed to determine the size of the orifice at the out flow of each compartment.

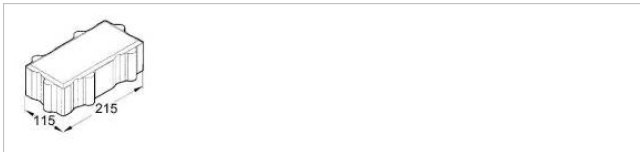
For System A where water infiltrates into the subgrade, no connections between dams are necessary.

Block Specification

Omega Flow Permeable Block Paving



Q24 12 115 117 119



Omega Flow Block Plan Dimensions

This contemporary, clean style will complement most environments and has been designed for use in either hand or machine lay applications and allows a variety of patterns to be easily achieved.

Omega Flow paving blocks come with a number of complimentary products including marker blocks, kerbs as well as an impermeable paving option which includes pencil edge blocks, bishops hat edging blocks.

The Omega Flow paving range is manufactured and tested to comply with BS EN 1338: 2003.

When tested to BS DD 229: 1996 for Surface Permeability Omega Flow achieved 4265 mm/h.

Brett Landscaping operate an integrated management system covering accreditation to BS EN ISO 9001: 2008 Quality Management System, a BS EN ISO 14001: 2004 Environmental Management System as well as an OHAS 18001: Health and Safety Management System.

Since 2010 Brett Landscaping also hold BES 6001 Responsible Sourcing of Construction Products certification to 'Very Good' which feeds into BREEAM along with the typical A+ / A Green Guide Rating for concrete block paving constructions.

Permeable Construction Materials

Permeable Construction Materials	Quantity	Unit
Omega Flow 80 mm	700.0	m ²
Jointing aggregate	5.8	ton
Laying course	45.5	ton
Hydraulically Bound Course Graded Aggregate	105.0	m ³
Course Graded Aggregate	136.5	ton
Membrane	980.0	m ²
Capping	189.0	ton

Summary of design information

Site

Adjacent paving area draining onto permeable pavement	0 m ²
Roof water draining onto Permeable Pavement	0 m ²
Permeable area	700 m ²
CBR Value	5%
Is there any history of pollution on site?	No
If so what is the classification of the waste material?	n/a
Has the water table been recorded within 1000mm below the top of formation?	
or	
Risk of contaminated water?	
or	
Sub grades susceptible to water infiltration and/or repeated loading?	No

Loading

Traffic Loading category	Category 4, 0.15 msa
Is a DBM layer required for construction traffic to run on ?	No

System

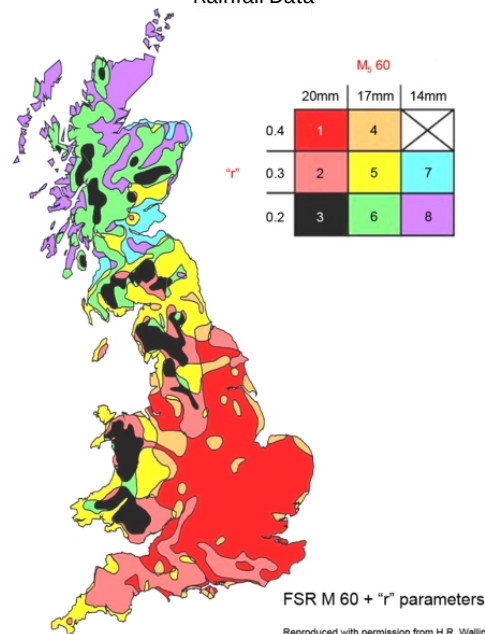
Type of system	System C
Discharge rate	31.9 l/s/ha

Sloping Site

Length	80.00m
Height difference	2.00m
Degree of slope	1.43°

Water Storage

Rainfall Data



Area Selected	2	M5-60 = 20mm, 'r'=0.3
Design return period	1 in 100 year event	
% for climate change	30%	

Additional Comments

1/2 Empty time

For lower allowable discharge rates (below 7 l/s/ha) and greater return periods (in excess of 1 in 100 year) the half empty time for the water storage can be in excess of 24 hours (typically up to 40 hours and sometimes greater). The SUDS Manual (Section 3.2.4) indicates that temporary storage should empty from full within 24 to 48 hours so that it can receive runoff from subsequent storms. Commonly a half empty time of 24 hours is used by design engineers. However the origins of this requirement need to be considered before applying it to storage designed for more extreme events. The requirement was initially stated in BRE 365 for soakaways designed to a 1 in 10 year storm event. The chance of such events following each other is quite high. However the chance of a 1 in 100 year +30% event being followed by a similar magnitude storm is much smaller and it is questionable whether the half empty requirements should be applied. Even if the storage does not half empty in 24 hours, there will still be significant storage capacity after this time to deal with smaller follow on storms.

This needs careful consideration and discussion with clients before deciding to increase available storage capacity.

With concrete block permeable paving the thickness of subbase is often dictated by the structural requirements of the pavement which often results in excess storage capacity already provided within the subbase. Typically if the subbase thickness is 10% to 20% greater than that required for hydraulic storage then half of the required storage will be available after 24 hours (for a 5 l/s/ha discharge).

The tables highlight where half empty times exceed 24 hours. If extra capacity is deemed necessary the subbase thickness can be increased to provide half the required storage capacity 24 hours after the end of the design storm. This is achieved as follows:

- Calculate total volume of water flowing out of subbase in 24 hours (i.e. storage that is available after 24 hours)
- Calculate 50% of design storage (i.e. storage required after 24 hours)
- Extra storage required = 50% of design storage – total water flowing out in 24 hours
- The extra storage should be added to the design storage to give a new total volume of storage.

Constructing permeable pavements on sloping sites is often unavoidable and without precautions, the water in the pavement will flow to the lowest point and collect, resulting in reducing the hydraulic storage capacity. To compensate, either the sub base thickness will need to be increased, or alternatively the pavement divided into terraces or internal check dams will be required.

Slopes

PermCalc automatically increases the hydraulic storage depth up to or equal to the structural depth required, excluding the thickness of DBM. If the hydraulic depth is still insufficient, then PermCalc will state the length of terracing or positions of check dams to maintain sufficient hydraulic storage.

Additional Comments Continued

Code for Sustainable Homes (CfSH)

The Code for Sustainable Homes is an environmental assessment method for rating and certifying the performance of new homes in England and Wales. It is a mandatory standard for use in the design and construction of new homes and is aimed at encouraging continuous improvement in sustainable home building as we move towards the target of Zero Carbon homes.

The Code for Sustainable Homes defines targets across a wide spectrum of new home construction and the use of permeable paving solutions can help to gain a significant number of points for the designer.

The most obvious of these comes from Category 4: Surface Water Run-off. This is a mandatory category and requires surface water drainage for housing developments which avoid, reduce and delay the discharge of rainfall run-off to watercourses and public sewers using Sustainable Drainage techniques (SUDS). This will thereby protect receiving waters from pollution and minimise the risk of flooding as well as other environmental damage in watercourses.

Compliance with Category 4 provides up to two credits, more importantly a failure to comply will render the whole project as unable to comply with the Code.

Additional credits can be achieved from other areas:

- One credit can be awarded by ensuring that there is no discharge from the developed site for rainfall depths up to 5 mm.
- One credit can be awarded by ensuring that the run-off from all hard surfaces shall receive an appropriate level of treatment in accordance with the CIRIA SUDS Manual to minimise the risk of pollution.
- Permeable paving can also be combined with other technologies such as water recycling or the development of natural habitats where it can play a part in improving the Code rating of the completed site.
- As a business Brett Landscaping are also able to supply information on the installation, operation and maintenance requirements of any permeably paved areas in a new development. This will then feed into the Site Management Plan which can help to gain additional points for the completed site.

These areas, allied to the typical A+ / A Green Guide Rating for concrete block paving products mean that these products can significantly help the developer to maximise the Code for Sustainable Homes rating for their project. Our Technical Support Team are always willing to assist in this aspect of design:

Overview of PermCalc Software

Introduction

Concrete block permeable pavements have a dual role acting as the drainage system as well as supporting traffic loads. They allow water to pass through the surface (between each block) and into the underlying permeable sub-base (either coarse graded aggregate and/or hydraulically bound coarse graded aggregate) where it is stored and released slowly, either into the ground, to the next SUDS management stage or to a drainage system. In the case of System C, no infiltration, the water captured can be harvested, as encouraged by the Code For Sustainable Homes.

Pavement Types

There are three principal systems suitable for concrete block permeable pavements – described as Systems A, B and C as defined in BS7533:13 *Guide for the design of permeable pavements constructed with concrete paving blocks and flags, natural stone slabs and setts and clay pavers*, published by the British Standards Institute.

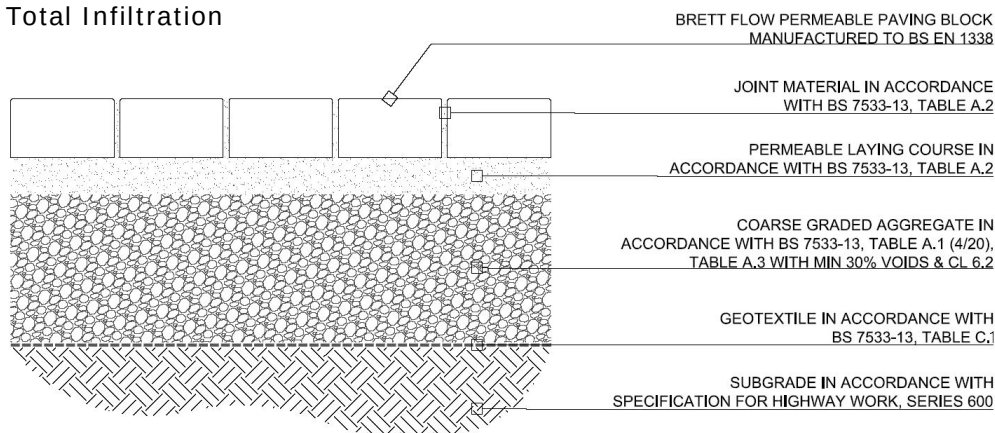
PermCalc can provide design suggestions for System A or System C permeable pavements.

System A is sometimes known as 'Zero Discharge' or total infiltration. This system allows all surface water on the pavement to infiltrate down through the joints between the blocks, passing through the sub-base layers below and eventually into the subgrade. Some retention of water will occur temporarily in the permeable sub-base layer allowing for initial storage before eventually infiltrating into the subgrade.

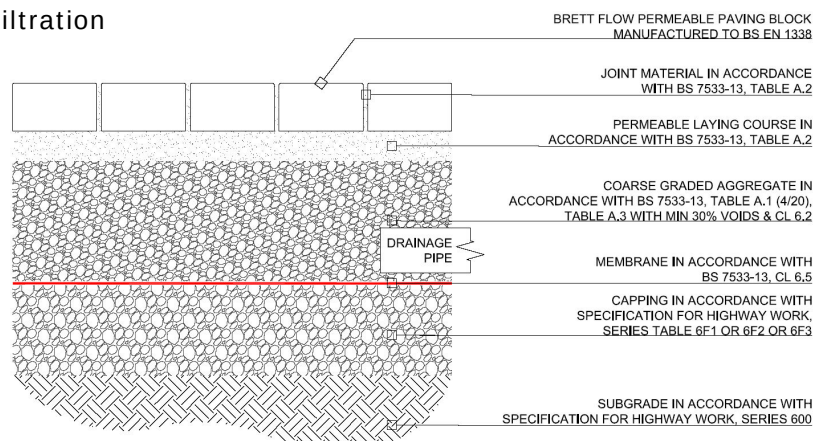
System C is sometimes known as no infiltration. This system allows for all surface water on the pavement to infiltrate down through the joints between the blocks, passing into the sub-base layers below complete, complete capture of the water is achieved using an impermeable, flexible membrane placed on top of the subgrade and up the side of the permeable sub-base to effectively form a storage tank.

System C is used in situations where the existing subgrade has a low permeability or low strength and would therefore be damaged by the introduction of additional water. It can also be useful for water harvesting or to prevent water soaking into the ground in sensitive locations such as water extraction zones. Outlet pipes are constructed through the impermeable membrane at suitable locations to transmit the water to sewers, watercourses or other parts of the SUDS management train.

System A - Total Infiltration



System C - No Infiltration

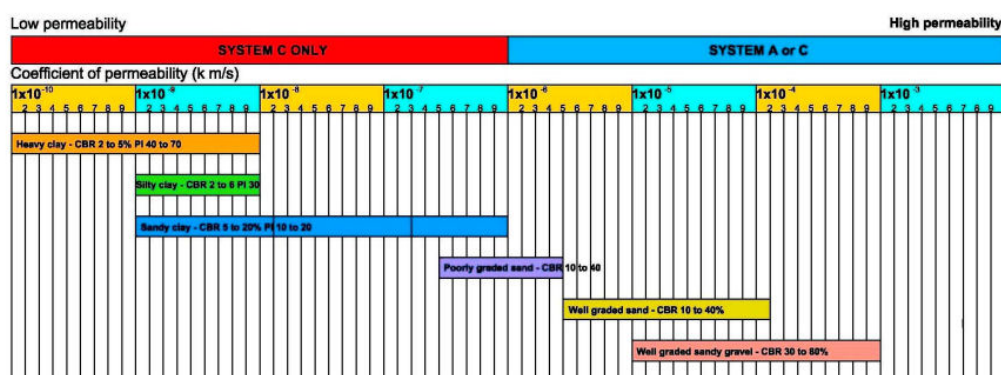


Selection of a Pavement System

One of the key criteria in selecting a pavement system is subgrade permeability which is established from appropriate tests on site.

The tables below give guidance on the appropriate selection of pavement systems (Systems A or C) for a range of sub-grade permeability, level of water table and the presence of pollutants in the ground.

		System A Total Infiltration	System C No Infiltration
Permeability of subgrade	10^{-6} to 10^{-3}	✓	✓
Coefficient of permeability k (m/s)	10^{-10} to 10^{-8}	✗	✓
Highest recorded water table within 1.0m of the formation level		✗	✓
Pollutants present in the ground		✗	✓



Design Methodology

Permeable pavements must be designed to achieve two aims:

Support the traffic loads over the design life of the pavement (structural design) and manage surface water effectively (hydraulic design). Therefore it is necessary to undertake a structural design and a hydraulic design and select the greater thickness of the permeable material from these calculations to determine the design thickness of the pavement. PermCalc automatically selects the design thickness.

Summary of the Permeable Pavement Design Procedure

Structural Design

- Assessment of traffic loading pre and post construction
- Assessment of sub-grade Californian Bearing Ratio (CBR) value
- Determination of sub bases thicknesses and material types
- If temporary access for construction traffic is to be provided, determination of the thickness of dense bitumen macadam (DBM)

Hydraulic Design

- Assessment of sub grade permeability k
- Selection of System A or System C
- Determine return period and rainfall characteristics
- Determine sub base thickness for water storage
- Allow for additional run off from adjacent areas and or roofs
- Check and if necessary increase the sub base thickness to allow for slopes
- Check and if necessary increase the sub base thickness to allow for a DBM layer

Select the greater permeable thickness

Brett Landscaping Ltd Design Disclaimer:

The PermCalc Permeable Pavements Design Calculator, the property of Brett Landscaping is provided as a tool to provide permeable pavement design suggestions. It is not a substitute for engineering skill and judgment and in no way replaces the services of a suitable professional, experienced, competent designer or engineer.

The calculation methodology is based upon the information given in BS7533:13:2009 *Pavements constructed with clay, natural stone or concrete pavers Part 13: Guide for the design of permeable pavements constructed with concrete paving blocks and flags, natural stone slabs and setts and clay pavers*, published by The British Standards Institute.

The notes for guidance used within this tool have been taken from the Interpave document 'Permeable Pavements: Guide to the Design Construction and Maintenance of Concrete Block Permeable Pavements Edition 6'. If further clarification of any points is required the complete guidance document can be downloaded at no cost from <http://www.paving.org.uk/permeable.php>

To determine the hydraulic storage requirements of a permeable pavement, it uses mapping information supplied by HR Wallingford Ltd. Whilst Brett Landscaping has used all reasonable efforts to ensure that the information contained within PermCalc is accurate, up to date and complete at the date of publication, no representations (expressed or implied) are made as to the accuracy, reliability, or completeness of such information. Brett Landscaping and HR Wallingford Ltd cannot be held liable for any loss arising (directly or indirectly) from the use of, or any action taken in reliance on, the information contained within PermCalc or any output performance report generated from PermCalc.

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