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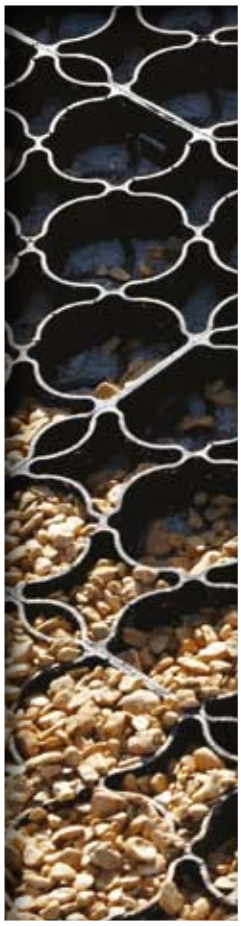
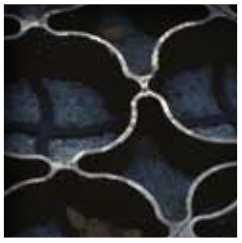


HANPAVE

Porous Paving System Specification Guide



HAHN
KUNSTSTOFFE

HANPAVE Porous Paving System

Hanpave™ porous paving is a high performance, durable and low maintenance plastic grid used as a surface solution for grass and gravel in a SUDS (Sustainable Drainage Systems) compliant permeable paving system.

Hanpave™ porous paving blocks are connected by an interlocking structure and installed on a porous base course. Their role is to transfer loads from the surface to the engineered course base below.

The purposes of SUDS (Sustainable Drainage Systems) are to minimise water runoff quantity, improve water quality and provide amenity and biodiversity. Both BREEAM and the Code for Sustainable Homes address the benefits of permeable paving as a SUDS technique and award credits accordingly. SUDS already form part of government planning policy.
Hanpave™ porous paving with a grass or gravel finish can be effective in:

- **Minimising water runoff quantity**
- **Improving water quality**
- **Providing clean water for amenity and biodiversity**

Product Benefits

- SUDS compliant. Hanpave™ porous paving with grass or gravel can improve project ratings in accordance with BREEAM & the Code for Sustainable Homes
- When laid, Hanpave™ offers excellent water permeation through the surface. It reduces the potential for clogging compared to an in situ concrete paving system
- Durable, non-rotting and weather resistant. Over 10 year expected product life
- The lightweight interlocking profile design enables ease and speed of installation.
- Load bearing capability at 250 - 350 tonnes/m^2, on a correctly specified and compacted sub-base
- Low maintenance & cost effective throughout the product life
- NBS Specification support in accordance with Q23 for gravel surfacing or Q30 for seeding/turfing
- Hanpave™ conforms to Part M of the Building regulations and is Disability Discrimination Act compliant when it is correctly laid and maintained
- Made from 100% plastic waste which might otherwise go to landfill. Hanpave™ reduces the carbon footprint of a project.
  It's fully recyclable at the end of its product life

Applications

- **Permanent and overspill car parks**
- **Emergency vehicle access roads, HGV service access routes**
- **Driveways, cycle routes & pathways**

Product Specification

- **Material:** 100% recycled polyethylene & polypropylene
- **Production process:** The polymer is blended and fed under high pressures into moulds
- **Load bearing:** 250 - 350 tonnes/m^2 on a correctly specified and compacted sub-base
- **Block dimensions:** 330 x 330 x 40 mm - 9 blocks per m^2
- **Cell profile:** 63 x 63 mm internal. Approx. 85% open cells/m^2
- **Weight:** 4.14kg/m^2
- **Connection type:** T slugs and slots
- **Colour:** Black
- **Delineators:** White circular inserts. Can be used to mark up areas such as parking bays and routes. 6 per continuous linear metre
- **Surface finish:** Gravel or Grass

Delineators

Simply push fit into the Hanpave™ blocks, before filling to create white lines, shapes and even words.

Diameter	Height	Colour

Hanpave™ Permeable Paving Specification & Installation Guide

The following are intended as a general guide in accordance with BS7533. For further details on permeable paving design refer to BS7533 Part 13; for installation refer to BS7533 Part 3.
The design for pavements should satisfy two parts - to support the traffic load and to manage the surface water effectively.

Subgrade Assessment

The strength of a subgrade is measured by California Bearing Ratio (CBR). The design CBR should be obtained either by testing or by measurement of the plasticity index of the subgrade material. In the case of CBR testing, the method described in BS1377-4:1990+A2:2002, Clause 7 should be used. The table below gives typical values for the subgrade strengths (the CBR).

The surface of the subgrade material should be prepared according to the Highways Agency's Specification for Highway Works, Clause 616. Detailed preparation of the subgrade should be in accordance with the recommendations in BS7533-3. An acceptable subgrade level should be free of any soft spots, reasonably parallel to the plane of construction. A capping layer may be required if the ground is structurally weak, likely to be subjected to exceptional loads or is significantly below the specified ideal formation level.

Table 1. Soil classification guide

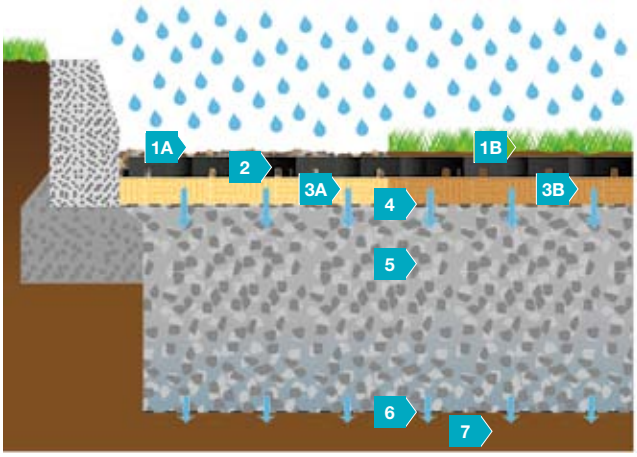
Soil classification	Typical range for coefficient of permeability, k (m/s)	Typical range of CBR values when read in conjunction with Table 2	Plasticity index
Heavy clay	10^{-10} to 10^{-8}	2 to 5	40 to 70
Silty clay	10^{-9} to 10^{-8}	3 to 6	30
Sandy clay	10^{-9} to 10^{-6}	5 to 20	10 to 20
Poorly graded sand	5×10^{-7} to 5×10^{-6}	10 to 40	—
Well graded sand	5×10^{-6} to 10^{-4}	10 to 40	—
Well graded sandy gravel	10^{-5} to 10^{-3}	30 to 80	—

Permeable Paving Systems

A permeable pavement is required to absorb 180 litres / second / hectare. Permeable paving with Hanpave™ can be an effective means of providing a structural pavement suitable for pedestrians and vehicular traffic whilst allowing water to pass straight through the surface into the pavement construction for temporary storage, storm attenuation and dispersal to the ground or collection. Generally, there are three permeable paving systems:

A. Full Infiltration System

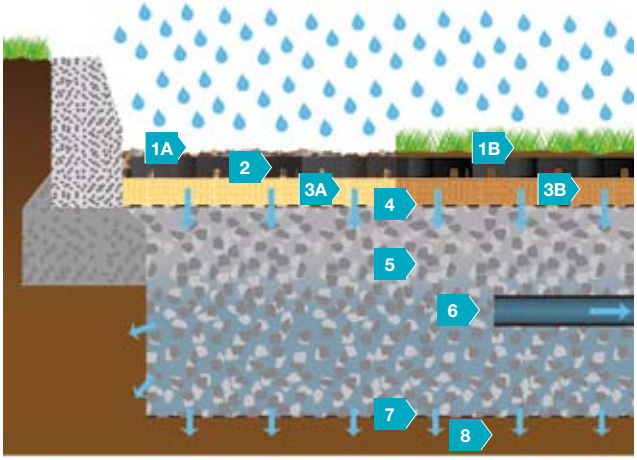
Suitable for existing subgrade with good permeability. The system allows all the water falling onto the pavement to infiltrate down through the constructed layers below and eventually into the subgrade. Some retention of the water will occur temporarily in the permeable sub-base layer allowing for initial storage before it eventually passes through. No water is discharged into conventional drainage systems, completely eliminating the need for pipes and gulleys, and making it a particularly economic solution.



1A	Gravel
1B	Grass
2	Hanpave™
3A	Laying course
3B	Root zone
4	Upper geotextile
5	Permeable sub-base
6	Lower geotextile
7	Subgrade

B. Partial Infiltration System

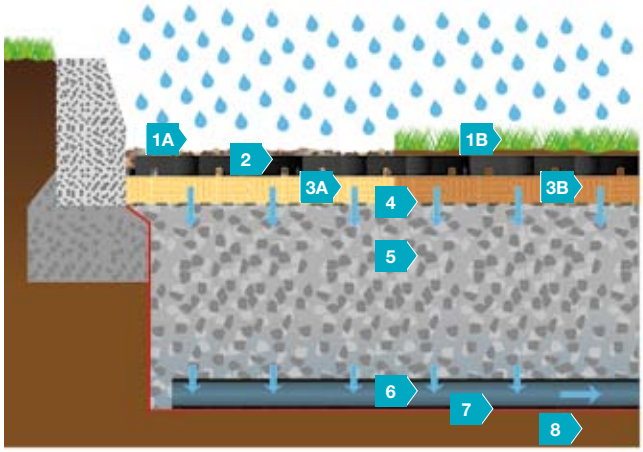
Used where the existing subgrade may not be capable of absorbing all the water. A fixed amount of water is allowed to infiltrate – which, in practice, often represents a large percentage of the rainfall. Outlet pipes are connected to the permeable sub-base and allow the excess water to be drained to other drainage devices, such as swales, watercourses or sewers.



1A	Gravel
1B	Grass
2	Hanpave™
3A	Laying course
3B	Root zone
4	Upper geotextile
5	Permeable sub-base
6	Drainpipe
7	Lower geotextile
8	Subgrade

C. No Infiltration System

Where the existing subgrade permeability is poor or contains pollutants, this system allows for the complete capture of the water. It uses an impermeable, flexible membrane placed on top of the subgrade level and up the sides of the permeable sub-base to effectively form a storage tank. Outlet pipes are constructed on top of the impermeable membrane to transmit the water to watercourses, sewers or other treatment systems. The system is particularly suitable for contaminated sites, as it prevents pollutants from being washed further down into the subgrade where they could reach groundwater.



1A	Gravel
1B	Grass
2	Hanpave™
3A	Laying course
3B	Root zone
4	Upper geotextile
5	Permeable sub-base
6	Drainpipe
7	Impermeable flexible membrane
8	Subgrade

System Selection

Table 2 below recommends appropriate pavement systems for a range of sub-grade conditions. Please read in conjunction with Table 1 for soil classification. For System A and System B, the highest recorded groundwater level should be greater than 1000mm below the bottom of the sub-base. This is to allow filtration of pollutants in the soil below the pavement and also to prevent groundwater rising and reducing the available storage in the sub-base.

Table 2. Guidance on selection of a permeable paving system

		System A - total infiltration	System B - partial infiltration	System C - no infiltration
Permeability of subgrade defined by coefficient of permeability, k (m/s)	10^{-6} to 10^{-3}	✔	✔	✔
	10^{-8} to 10^{-6}	✗	✔	✔
	10^{-10} to 10^{-8}	✗	✗	✔
Highest recorded water table within 1000mm of formation level		✗	✗	✔
Pollutants present in subgrade		✗	✗	✔

Sub-base Thickness

The design of the pavement is approached by considering the sub-base thickness required to meet both the hydraulic factors and the loading factors. The greater sub-base thickness identified for either of these factors is adopted.

- **Hydraulic factors -** The design should take into account the water storage volume in the sub-base and the rate of infiltration/ restricted outflow rate. The thickness of the sub-base required to provide sufficient water storage capacity can be obtained using Table 3.

Table 3. Sub-base thicknesses to provide sufficient water storage capacity for Systems A, B & C

Rainfall data	r [A]	Required sub-base thickness (mm)					
		1 in 30 year event		1 in 100 year event		1 in 100 year event plus 20% climate change	
		Systems A & B	System C	Systems A & B	System C	Systems A & B	System C
M60 [B] = 20 mm	0.4 0.3 0.2	120 140 180	120 140 180	160 190 250	160 190 250	210 240 310	210 240 310
M60 = 17 mm	0.4 0.3 0.2	100 110 150	100 120 150	140 160 210	140 160 210	180 210 270	190 210 270
M60 = 14 mm	0.4 0.3 0.2	— 90 110	— 90 120	— 130 170	— 130 160	— 170 220	— 170 220

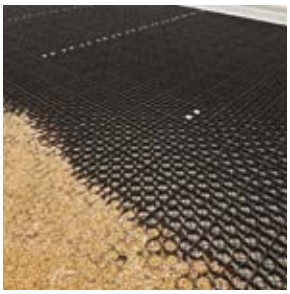
A) Ratio of a 60 minute storm rainfall depth to the depth of the 2-day maximum rainfall depth.
B) 60 minute storm recurring every 5 years.

- **Load Categories -** The design has to take into account the cumulative amount of traffic which the pavement has to carry, measured either in terms of the number of commercial vehicles per day (cv/d), or alternatively, the number of standard axles. Table 4 below gives indication on the loading categories of some typical applications.

Table 4. Loading categories

Category	No. of standard axles	Traffic guide	Typical applications
Domestic	0	No large HGV	- Patios - Private drives - Decorative features - Enclosed playgrounds - Footways with zero overruns
Car parking	100	Emergency vehicles only	- Car parking bays and aisles - External car showrooms - Sports stadium pedestrian routes - Footways with occasion overruns - Footway crossovers
Lightly trafficked roads	15000	1 large HGV/week	- Nursery access - Parking areas to residential developments - Garden centre external displays - Cemetery/crematoriums - Airport car parks (no bus pick-up) - Sports centres






Tables below show the pavement course thickness and material type suitable for subgrades with a CBR ≥ 15%.

Table 5. Systems A & B – selection of pavement course material and thickness

Category/application	Hanpave™ block/laying course (mm)	Hydraulically bound base (mm)	Coarse graded material (mm)
Domestic	40 / 40-50	-	250
Car parking	40 / 40-50	-	350
Lightly trafficked roads	40 / 40-50	125	150

Table 6. System C – selection of pavement course material and thickness

Category /application	Hanpave™ block /laying course (mm)	Hydraulically bound base (mm)	Coarse graded material (mm)	Capping layer (mm)
Domestic	40 / 40-50	-	250	150
Car parking	40 / 40-50	-	350	150
Lightly trafficked roads	40 / 40-50	125	150	150

The additional thickness to be provided in the case of low CBR can be taken from Table 7 for Systems A and B and Table 8 for System C. The use of geotextile / grid reinforcement products can enhance the load bearing capability of the subgrade. Further advice should be sought from the relevant manufacturers.

Table 7. Additional thickness of coarse graded material for Systems A and B

CBR of subgrade (%)	Adjustment of coarse graded material (mm)
1	300 [A) B)]
2	175 [B)]
3	125 [B)]
4	100 [B)]
5	Use table 5 for thickness
8	Use table 5 for thickness
10	Use table 5 for thickness
15	Use table 5 for thickness

A) Expert guidance should be sought.
B) Subgrades of CBR less than 5% are often too fine to permit sufficient infiltration.

Table 8. Total thickness of capping material for System C

CBR of subgrade (%)	Adjustment of capping layer (mm)
1	600 [A)]
2	350
3	250
4	200
5	Use table 6 for thickness
8	Use table 6 for thickness
10	Use table 6 for thickness
15	Use table 6 for thickness

A) Expert guidance should be sought.

Material Selection

In a permeable pavement system, there is a requirement for stiffness but the base aggregate also needs to be permeable to allow water to flow through it and to have sufficient void space for water storage. Conventional DTp Type 1 sub-base is not recommended.

Sand and gravel with rounded particles should not be used in permeable pavement sub-base construction. Two gradings of sub-base material for permeable paving are given in Table 9 below, conforming to BS EN12620:2002 GC 90/15 4/40 and 4/20 coarse aggregates.

Table 9. Sub-base material gradings for permeable paving

Sieve size (mm)	Percentage passing	
	Coarse aggregate, 4/40	Coarse aggregate, 4/20
80	100	—
63	98-100	—
40	90-99	100
31.5	—	98-100
20	25-70	90-99
10	—	25-70
4	0-15	0-15
2	0-5	0-5
1	—	—

Table 10. Laying coarse material gradings for permeable paving

BS Sieve size (BS EN993-1) (mm)	Percentage passing
14	100
10	98-100
6.3	80-99
2.0	0-20
1.0	0-5

Note: Necessary measures should be taken to prevent migration of the laying course material into the sub-base, e.g. by using a geotextile or by using compatible gradings of laying course and sub-base materials.

Installation Notes

- The preparation of the subgrade, the construction of the sub-base and the construction and type of roadbase (if present) should generally be in accordance with relevant current practice as described in the Highways Agency's Specification for Highway Works.
- It is essential that the sub-base compaction is thorough, using a vibrating plate compactor or vibrating roller.
- The thickness of the laying course after final compaction of the surface course should be 40 - 50mm, within an accepted surface level tolerance. All areas of prepared laying course material should be protected and not left exposed overnight.
- The laying course may be placed and screeded using a mechanical device.
- It is necessary to include a substantial edge restraint when constructing Hanpave™ permeable paving with grass / gravel finishes.
  Edge restraints need to be sufficiently robust to withstand override by any anticipated traffic, to withstand thermal expansion and to prevent loss of laying course material. Typical examples of edge restraints are kerbs, channels, established structures, and rigid abutments such as securely fixed paving units.

Laying Hanpave Blocks

Place the blocks onto the prepared sub-base and laying course. The leading edge of the blocks should have the fixing lugs exposed for quick installation. No pegging is required. Always protect the outer edge with edging strips. Stand on laid blocks when laying the next row.

- An expansion gap at 0.1mm per metre per °C should be incorporated along the edges.
- Connect the blocks using lugs and slots, progressing over the area in rows.
- Blocks can be cut to fit around obstructions and contours. Any that need to be cut should be measured and cut prior to installation where possible leaving full, complete cells along the outer edge. Cut pieces less than half of the original size should be avoided where possible.
- Hanpave™ delineators can be inserted into the porous paving blocks before filling, to create lines, shapes and even words.

Surface Finish

Gravel

- Fill the porous paving blocks to the top of the cells with gravel in accordance with NBS section Q23 for gravel surfacing. The use of 6 - 10mm angular aggregate is recommended to acheive the best result.
- A light vibrating plate can be used to consolidate the blocks and to settle the gravel. Top up the cells as required after settlement. Do not overfill.
- The surface may be trafficked immediately.
- Over time top up gravel as necessary.

Grass

- An optional weed suppressant membrane can be used on top of the sub-base before applying the sharp sand. This will prevent weed growth but will allow for natural drainage of rain water to the ground below.
- Carry out seeding in accordance with NBS section Q30 for seeding or turfing.
- Use a 70/30 or 60/40 root zone mixture. Initially fill to 7 - 10 mm below the top surface of each grid as this will protect the grass in its early growing phase.
- A light vibrating plate can be used to consolidate the blocks and to settle the root zone infill.
- The whole area can then be seeded and watered. A very light top dressing may be applied to just cover the seed and to provide adequate germination conditions. Do not overfill.
- The surface should not be trafficked immediately. Allow the grass to fully establish prior to use, typically 8 weeks.

Notes:

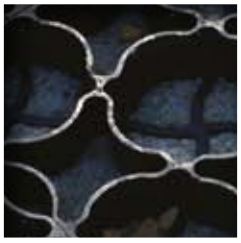
1. Maximum advised gradient for traffic applications without pegging: 5%

2. During the design stage, consideration should be given to the potential for extraordinary use of the surface. The incorporation of bays and edges in design layout and/or the setting of a speed limit of 10 - 15 miles / hour or other calming methods to avoid heavy braking is advised if there is a possibility of abusive use.

Call us today on
Tel: +49 (0) 6543 9886 0
for more information on
Hanpave porous paving blocks.
Alternatively email us on
export@hahnkunststoffe.de

References:

- **BS7533-3:2005 + A1:2009**
- **BS7533-7:2010**
- **BS7533-13:2009**
- **BS EN13242:2002 + A1:2007**
- **The Highways Agency:**
  Specification for Highway Works
- **The Environment Agency:**
  Guidance on the permeable surfacing of front gardens
- **Building Regulations 2010**
  Approved Document M1
  Access and Use



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HAHN
KUNSTSTOFFE

HAHN Kunststoffe GmbH
Gebäude 1027, 55483 Hahn-Flughafen, Germany
Phone: +49 (0) 6543 9886 - 10
Fax: +49 (0) 6543 9886 - 96
Email: export@hahnkunststoffe.de
Web: www.hahnkunststoffe.com