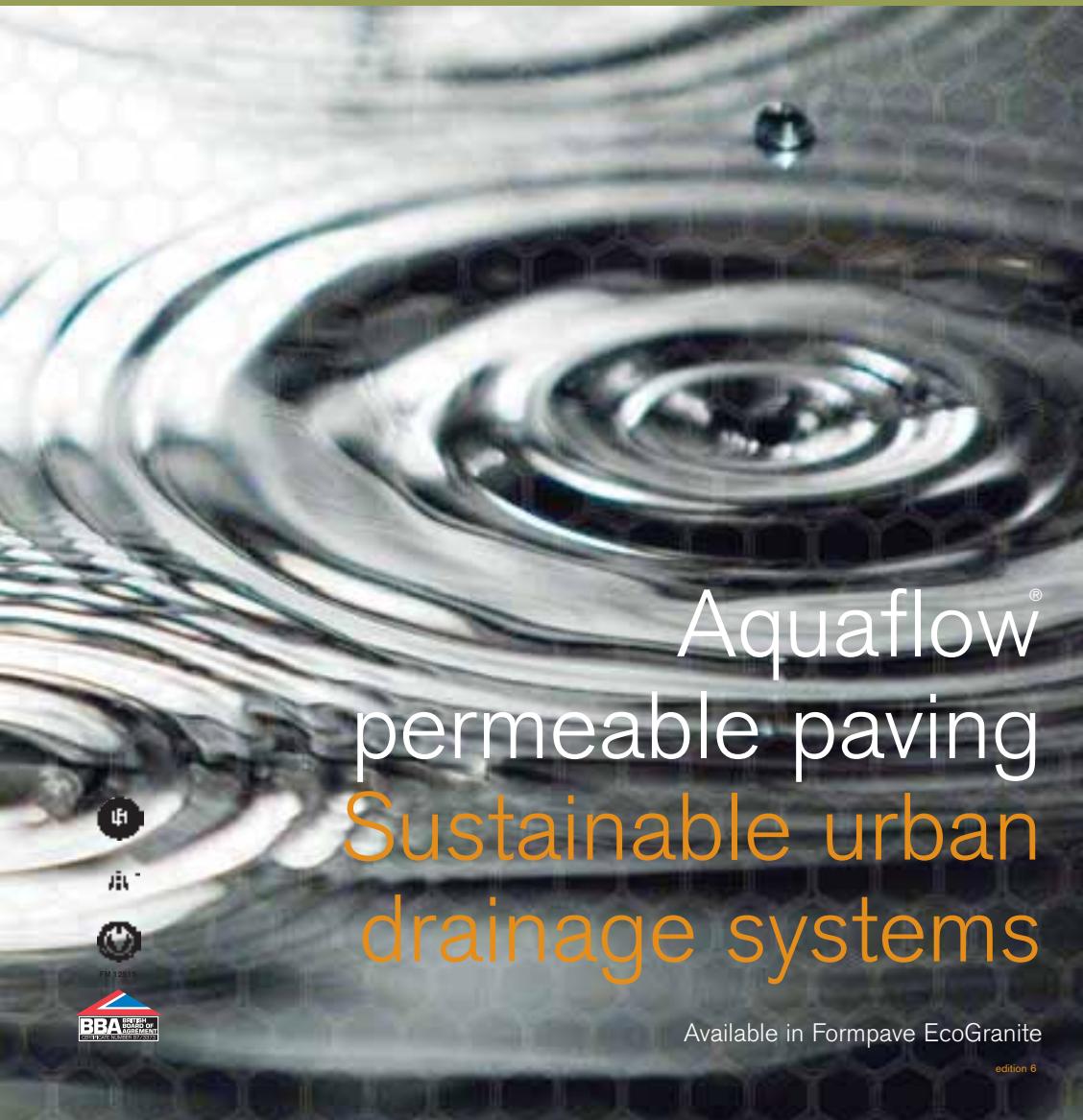
Formpave



Aquaflow® permeable paving

Sustainable urban drainage systems

Available in Formpave EcoGranite

edition 6

Hanson Formpave
Situated at Coleford in the Royal Forest of Dean, the Hanson Formpave works is one of the most sophisticated of its type in Europe. The technology used in the works and the Company's quality assurance scheme provides complete works traceability of every block made. The works has BS EN ISO 9001: 2000 Quality Assurance accreditation and Hanson Formpave is a BSI registered company.

If you would like information on Hanson Formpave's other products please visit our web site www.formpave.co.uk or call our Sales office on 01594 836999.

FM 12515

Sustainable urban drainage system
Aquaflow® permeable paving

Formpave

Used on hundreds of contracts worldwide Tested over15 years Water harvesting Clean and controlled water discharge Bioremediation of hydrocarbons Retention of heavy metals Design service available BBA certification Formpave EcoGranite An Aquaflow surface has the capacity to deal with rainfall intensities approximately 90 times greater than that required by the regulations.* Formpave also manufacture a comprehensive range of pavers, kerbs and fittings.

The Aquaslab, Aquasett and Aquaflow block is available in Formpave EcoGranite, an environmental alternative to the use of freshly quarried granite. Formpave's unique granite mix includes both Stent and Slag; by-products of Cornish China Clay and the South Wales steel industry.

** New Building Regulations* became effective on 1 April 2002

Sustainable urban drainage system
Aquaflow® permeable paving

All information contained in this brochure is based on typical schemes. Therefore it is recommended that each site should be designed to suit its individual specific conditions and restrictions.

Formpave's sustainable urban drainage systems and Aquaflow permeable paving products are suitable for use on: Car parks, Industrial estates, Retail centres, Pedestrian areas, Domestic drives, Motorway services, Airport service areas and aprons, Garages, Lorry parks and other heavy duty applications.

New Building Regulations became effective on 1 April 2002 and for the first time address the topic of drainage from hard surfaces by means of a permeable surface. In paragraph 2.4 the regulations state that a rainfall intensity of 0.014 litres per sec per m^2 can be assumed for design purposes.

Aquaflow, the permeable paving products designed to be used with the Formpave sustainable urban drainage system, let through 2.5 litres/sec/m^2.

An Aquaflow surface has the capacity to deal with rainfall intensities approximately 90 times greater than that required by the regulations.

The Problem Increasing urbanisation and rapid run-off have put a tremendous strain on conventional storm water drainage systems. This has resulted in sewers and culverts becoming overloaded during periods of heavy rain and contamination of streams and rivers.

Heavy metals, hydrocarbons, rubber dust, silts and other detritus are all deposited on impermeable surfaces during dry weather. These are scoured off such surfaces during periods of heavy rain and transported at best into expensive treatment works, or directly into rivers and streams where they cause severe environmental damage.

SUDS should be used on all sites to minimise the impact of the development on the environment. In Scotland the use of the SUDS approach is a legal requirement.

The Solution - Source Control Sustainable Urban Drainage Systems (SUDS) are increasingly being used to prevent run-off and flooding, and as a method of collecting and cleaning storm water.

The Formpave sustainable urban drainage system allows heavy rain to infiltrate through a permeable concrete block paved surface into a unique sub-base before being released in a controlled manner into sewers or water courses.

Discharge rates in accordance with greenfield run-off can be readily achieved if required. Alternatively, if the underlying sub-grade is suitable the water can be infiltrated directly into the sub-grade.

The water leaving the Formpave Aquaflow system is cleaned by filtration and microbial action and can be used for secondary non-potable uses such as flushing toilets and watering soft landscaping.

A further advantage of the system is that roof water can be drained directly into the sub-base via a rodable sump, or if siphonically drained, through a dispersion chamber.

Sustainable urban drainage system

There are 3 system designs
Each design can be tailored for infiltration or tanked and to fulfil the requirements of the project:

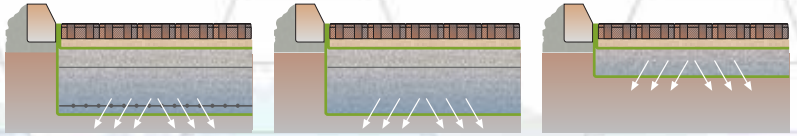
Infiltration Used to infiltrate the water directly into a suitable sub-grade.

Tanked Used to attenuate water before release, harvesting for re-use or where difficult or contaminated sub-grades are encountered.

1 For a sub-grade CBR of between 2-5%
Parking areas subject to trafficking by cars and vans only.

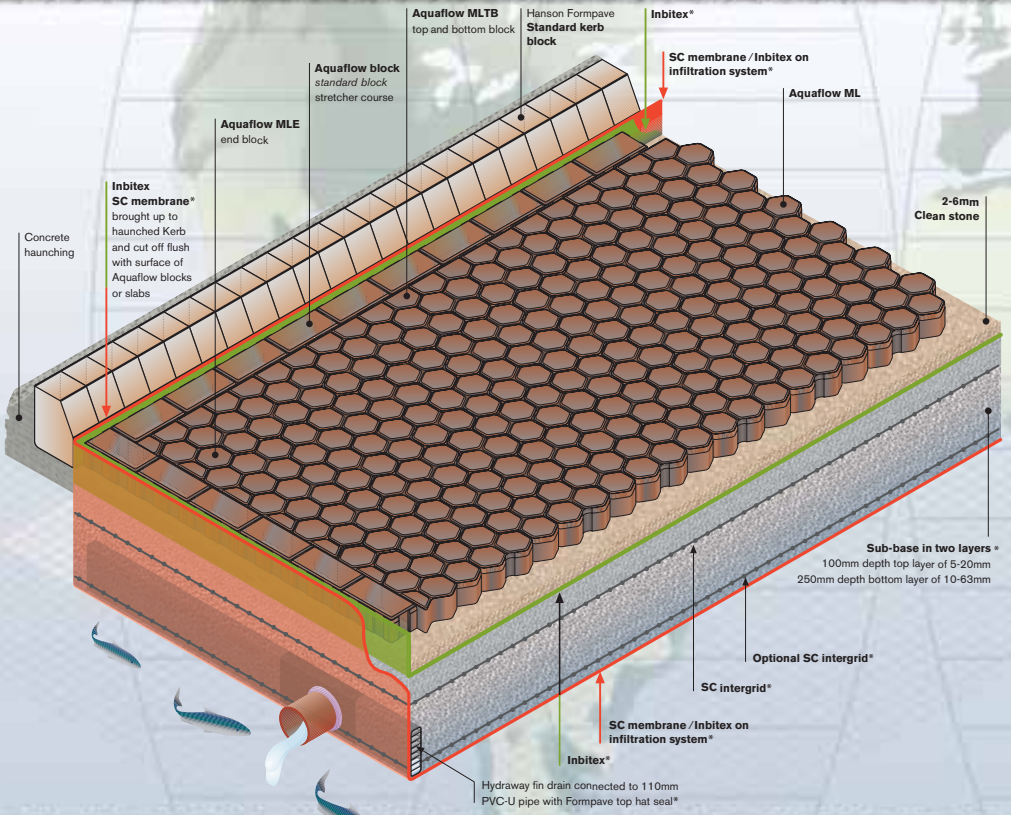
2 For a sub-grade CBR of 5% or greater
Parking areas subject to trafficking by cars and vans only.

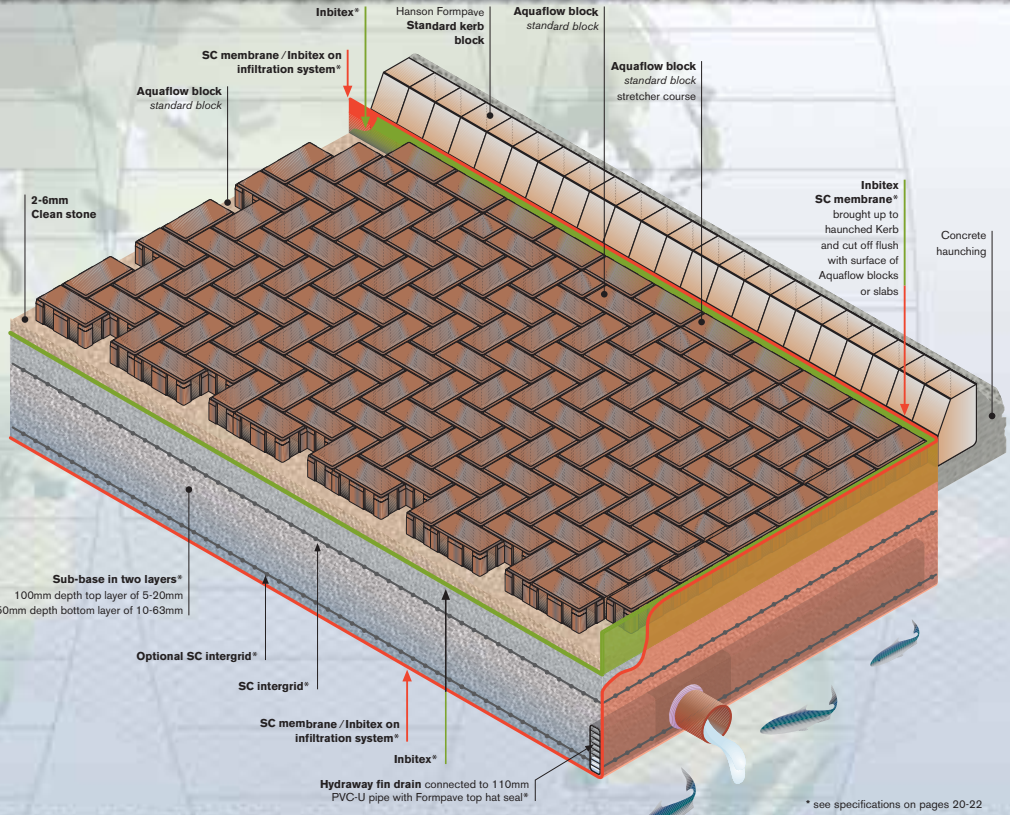
3 For a typical footpath construction
For Aquaflow, Aquasett and Aquaslab paving.



The diagrams illustrate the three designs applied to a typical Infiltration system which uses two pervious inbitex geotextiles. On Tanked systems the underlaying pervious geotextile is replaced with an impervious SC membrane.

See page 6 for detailed information





* see specifications on pages 20-22

W O R L D L E A D E R S I N S U S T A I N A B L E U R B A N D R A I N A G E S Y S T E M S

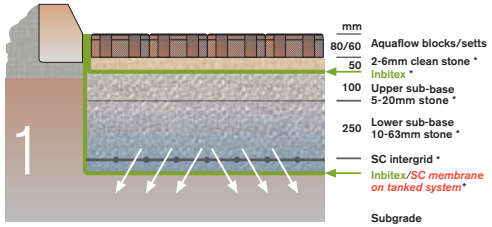
The isometric drawings show a tailored Tanked system. The Tanked system is available in the three designs described above.

Each of the 3 basic system designs can be tailored for infiltration or tanked to fulfil the specific requirements of the site.

The diagrams illustrate the three designs applied to a typical Infiltration system which uses two pervious inbitex geotextiles. On Tanked systems the underlaying pervious geotextile is replaced with an impervious SC membrane.

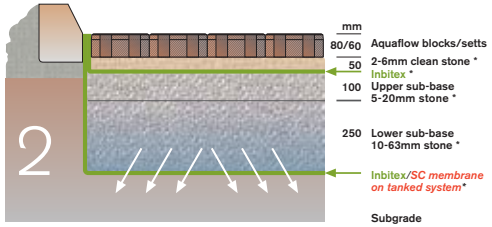
Typical system with a sub-grade CBR of between 2-5%

Parking areas subject to trafficking by cars and vans only



Typical system with a sub-grade CBR of 5% or greater

Parking areas subject to trafficking by cars and vans only

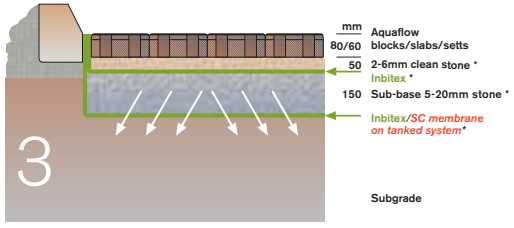


Inbitex® - thermally bonded nonwoven geotextile
Inbitex® has been specifically developed to optimise the cleansing of water entering the system. The various characteristics have been combined to create a unique geotextile that aids the development of the naturally occurring microbes, and offers them refuge during periods of drought.

For further information see page 21.

Typical footpath construction

For Aquaflow/Aquasett /Aquaslab paving



Hanson Formpave design team:
01594 836999 or
designservices@formpave.co.uk

* See specification on pages 20-22

Infiltration

The system is underlaid with a pervious geotextile (Inbitex) and is suitable for use where it is proposed to infiltrate the water directly into a suitable sub-grade.

Tanked

The system is underlaid by an impervious membrane (SC membrane) and is suitable for use where it is proposed to attenuate storm water before releasing it in a controlled manner, harvest the water for re-use or where difficult or contaminated sub-grades are encountered.

The type of membrane used and the method of sealing will depend upon the application. In some circumstances the membrane will require additional protection from puncturing and specialist advice should be obtained.

The impervious membrane restricts water entering the sub-grade, and preserves sub-grade structural integrity. This is very important where clay sub-grades are encountered.

Where a completely watertight system is required a welded membrane should be used at formation level.

Laying course material and sub-base

Both the Tanked and Infiltration systems utilise the same laying course and sub-base materials.

Depth of sub-base can be varied to suit requirements of the engineer.

The sub-base stone must be crushed, possess well defined edges and be in accordance with the Los Angeles coefficient carried out to the requirements of EN 1097-2 1998 clause 5.

Grading of lower sub-base stone

BS Sieve size	% passing
100mm	100
63mm	90-100
37.5mm	60-80
20mm	15-30
10mm	0-5

photograph copyright of Sustrans

The Aquaflow® range of permeable paving

Formpave have designed a range of Aquaflow paving blocks to be used in conjunction with either tanked or infiltration systems.

The range consists of six blocks manufactured from concrete with a tensile splitting strength in accordance with BS EN 1338:2003.

Included within the range is the Aquaslab which has been designed for use on non-trafficked pedestrian areas.

All of the blocks and slabs provide drainage through vertical channels and will allow water through the surface at a rate of approximately 9000mm per hour (9000 litres per m^2 per hour). The Inbitex geotextile beneath the laying course will allow approximately 4500 litres per m^2 per hour through and this figure should be used for design purposes.

The Aquaflow ML block system consists of an interlocking block with specialist top, bottom and edge blocks and has been specifically designed for heavy duty applications.

The ML blocks can be laid by hand or by machine. Where the blocks are machine laid modules of .65m^2 are laid in one pass. Laying rates of over 600m^2 per day have been readily achieved with a three man crew.

• **Other colours and finishes such as EcoGranite are available to special order.**

Aquaslab®

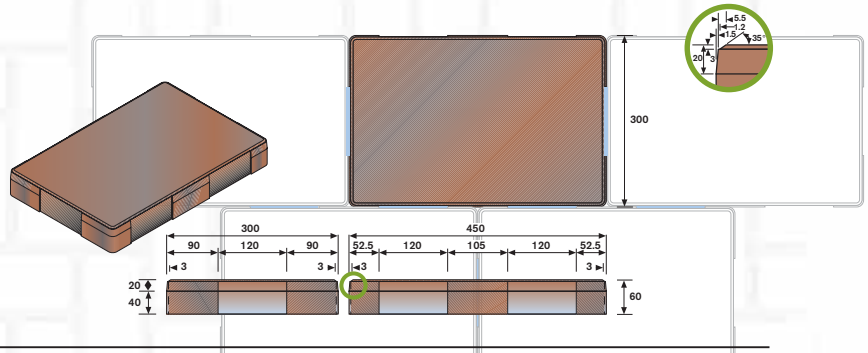
For use on Pedestrian areas

Size
300 x 450 x 60mm

Laying pattern
Staggered stretcher bond

Colours*
Natural, Burnt Red, Red brindle, Golden brindle and Charcoal

Finish
Standard
Bush hammered to special order



Aquasett®

For use on footpaths, domestic drives and roads (80mm)

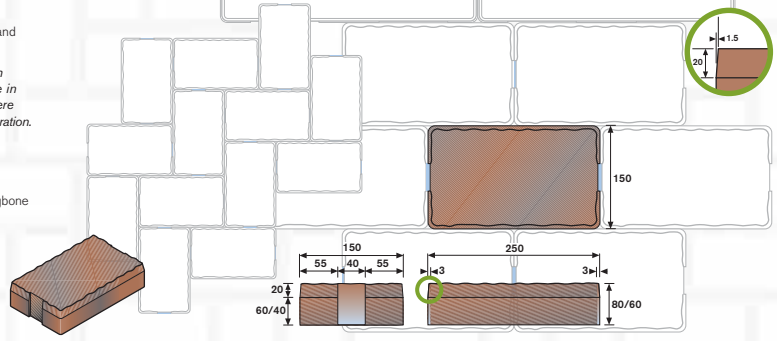
Range of colours and the Olden finish make the Aquasett appropriate for use in conservation areas or on projects where architectural heritage is a major consideration.

Sizes
150 x 250 x 60/80mm

Laying pattern
Staggered stretcher bond or 90° herringbone for trafficked areas.

Colours*
Traditional, Red Brindle, Vendage and Pennant.

Finish
Olden
Bush hammered to special order



Aquasett combined®

For use on footpaths and domestic drives

Range of colours and the Olden finish make the Aquasett combined appropriate for use in conservation areas or on projects where architectural heritage is a major consideration

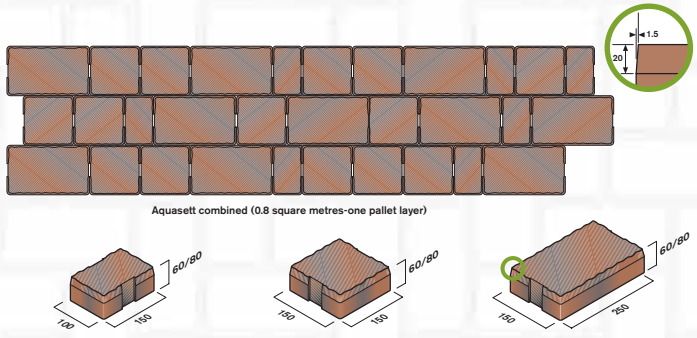
Sizes
Large 150 x 250 x 60/80mm
Medium 150 x 150 x 60/80mm
Small 100 x 150 x 60/80mm

Ratio of blocks in 0.8 square metre manufactured format: 10 large, 14 medium and 7 small.

Laying pattern
Staggered stretcher bond

Colours*
Traditional, Red Brindle, Vendage and Pennant.

Finish
Olden
Bush hammered to special order



Aquaflow block®

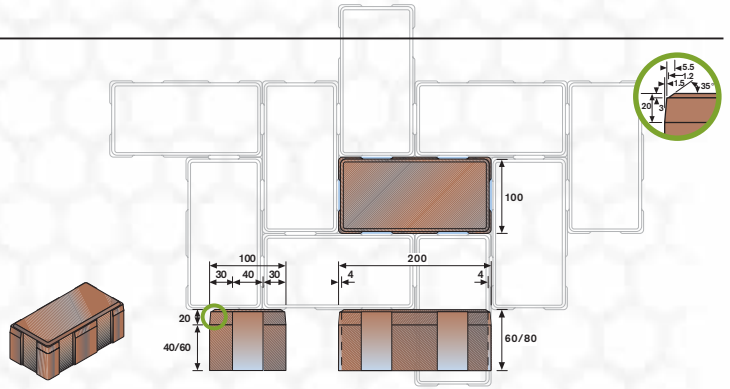
For use on car parks, drives and moderately trafficked areas

Sizes
100 x 200 x 60/80mm

Laying pattern
Must be laid in 90° herringbone

Colours*
Natural, Burnt Red, Red brindle, Golden brindle and Charcoal.

Finish
Standard
Bush hammered to special order



Aquaflow ML block®

For Roads and heavy duty use

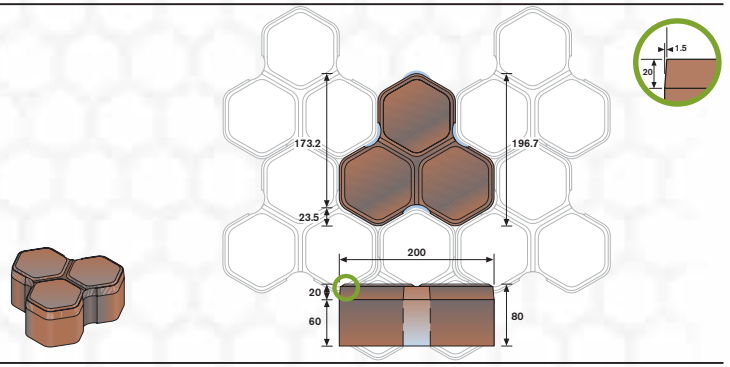
Size
80mm

Laying pattern
Include stretcher course around edge in conjunction with MLE and MLTB

Colours*
Natural, Burnt Red, Red brindle, Golden brindle and Charcoal.

Finish
Standard

Not available in EcoGranite



Aquaflow MLE® *top drawing*

End block
For use with Aquaflow ML blocks

Aquaflow MLTB® *bottom drawing*

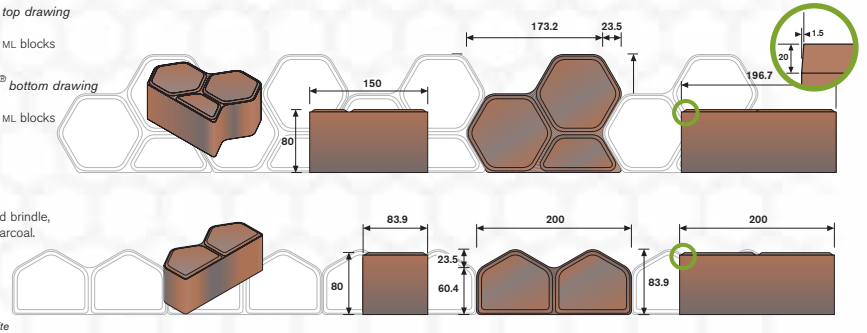
Top and bottom block
For use with Aquaflow ML blocks

Size
80mm

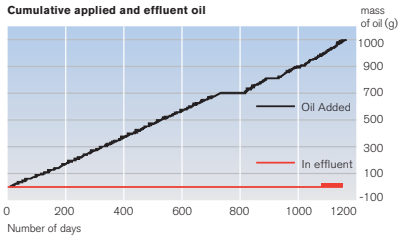
Colours*
Natural, Burnt Red, Red brindle, Golden brindle and Charcoal.

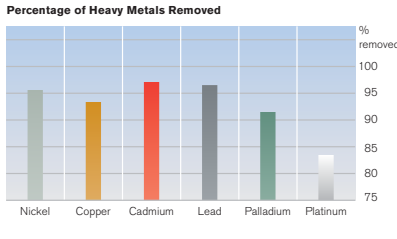
Finish
Standard

Not available in EcoGranite



System details - principal benefits





Data provided by the kind permission of:

Cumulative applied and effluent oil *Stephen Coupe, University of Coventry.*

Percentage of Heavy Metals Removed *Dr Chris Jefferies and Fiona Napier, Urban Water Technology Centre, University of Abertay, Dundee.*

Lower construction costs Control of run-off Aquaflow hydraulic performance Quality of discharge water Water harvesting and re-use Geothermal heating and cooling Roof water Maintenance and performance Heavy duty use Design criteria Design service

Lower construction costs
From experience it has been shown that total construction costs are lower than conventionally drained surfaces.

When using the Formpave Aquaflow system it is not necessary to incorporate the gullies, drainage pipes, drain runs, oil and silt traps and flow control mechanisms that are needed for traditional drainage.

When comparing relative costs it is important that all costs associated with traditional drainage are incorporated. e.g. gullies, channels, hydraulic controls, detention ponds, petrol interceptors, culverts etc.

It should be noted that the Formpave sub-base is open textured and therefore has a greater rate of spread than Highways Agency Type 1 sub-base.

Formpave specified sub-base stone weighs approximately 1.8 tonnes per m^3.

Type 1 sub-base stone weighs approximately 2.2 tonnes per m^3 (based on carboniferous limestone).

Control of run-off
Run off during periods of heavy rain is eliminated. Aquaflow products allow water to infiltrate through the surface of the system at a rate of approximately 9000mm per m^2 per hour.

Aquaflow hydraulic performance
For rainfall events with small rainfall depths (5mm and below) there is no effective runoff from a permeable pavement.

The results show that for short duration events there is significant attenuation of the peak discharge.

The peak discharge from the pavement is less than the flow rate falling onto the pavement and for long duration rainfall events, equilibrium conditions are achieved - the outflow matches the inflow rate.

One can expect a variability in the response to a given rainfall event depending upon antecedent rainfall. The overall performance is not significantly affected by the antecedent conditions if the event is significant.

The results of the study show that permeable pavements empty rapidly and easily satisfy the requirements on the time to half empty to avoid potential flooding from multiple storms.

For short duration events, of the order of 30 minutes or less, the peak discharge appears to be relatively insensitive to the length of the pavement, up to realistic lengths. This emphasises the effectiveness of permeable pavements in attenuating peak discharges for short duration events.

The model analysis indicated that under most conditions within the permeable pavement the depth of flow is small and flow velocities are low.

Thus proving reduction in surface water run-off to sewers and water-courses during peak storm events.

Extract from an independent study undertaken by H R Wallingford Limited

Discharge water
The compacted sub-base has a voids ratio of approximately 30% which allows storm water to be attenuated within the system and released in a controlled manner over a period of time.

Discharge rates in accordance with greenfield run-off can be readily achieved if required. Where the underlying sub-grade is suitable, water can be infiltrated directly into the ground. Infiltration can be considered even where the sub-grade would not be suitable under BRE Digest 365 criteria. The reservoir capacity of the sub-base allows water to be stored before slowly infiltrating over a period of time.

Approximately 30% of water entering the system is lost through evaporation and does not leave in the form of exit water.

Quality of discharge water
Analysis of exit water from the system has shown it to be as clean as the water discharged from a modern sewage works.

The layers of stone and geotextile act as a type of trickle filter. Organic matter, silt and loam is caught by the geotextile and held within the laying course. Heavy metals have an affinity to particulates; adhering to the surface of the organic matter and silt. They are therefore stabilised and retained within the sub-base.

Hydrocarbons are digested by a population of naturally occurring microbes. Research undertaken at Coventry University on microbial growth has shown that the system is capable of degrading at least 400g of oil per m^2 per annum.

The Environment Agencies have confirmed that silt traps and oil interceptors are not required as the system catches silts and degrades oils.

An additional advantage is that water exiting the system has a pH of approximately 7.5. (UK rainfall has a ph of approximately 4.5)

continued overleaf

Water harvesting and re-use
A number of sites are harvesting and re-using water directly from the system.

Youth hostels and schools are using the water for non-potable purposes such as flushing lavatories and a large garden centre is using this resource to water plants and soft landscapes. It has been found that water from the Formpave Aquaflow system is kinder to plants than tap water.

The Hanson-Formpave water recycling system collects rainfall in the base of a tanked permeable pavement. Water falling onto the pavement surface and that coming from adjacent roofs is collected and this water is cleaned by the Inbitex geotextile layer before storage. The recommended uses for this water are toilet flushing, garden watering and car washing. Together, these uses can reduce by 50% or more the household requirement for mains water.

A driveway of 40m^2 when full of rainwater can provide enough water for around 1 months use even with no extra rainfall.

Geothermal heating and cooling
Hanson-Formpave presents a pavement-based system capable of reducing a building's reliance on gas or electricity for heating and cooling by up to 80%. A patented system for heat capture from stored water can be used to generate 6 kilowatts of energy for indoor climate control. A heat pump moves the heated or cooled water through either underfloor heating or radiators. The payback period on the system is typically between 3 and 6 years after which, other than the cost of running the heat pump, heating and and cooling costs are completely removed.

Roof water
Roof water can be discharged in to the sub-base. See page 17 for design details.

With gravity fed drainage it is recommended that the water is introduced into the sub-base by means of a sump with a manhole cover adjacent to the paved area. Any debris can be easily caught and cleared. The water is then dispersed within the system via a distribution tank.

Where siphonic drainage is proposed it is recommended that you contact the Hanson Formpave design team 01594 836999.

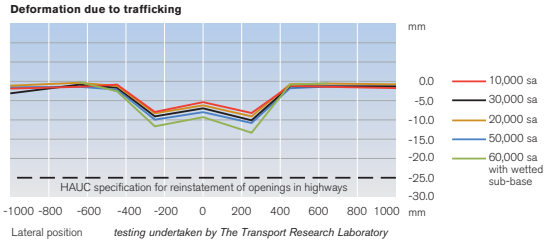
Maintenance and performance
The surface has a design life equivalent to standard block paving. The surface blocks require simple routine maintenance - *see page 24: maintenance specification.*

Professor John Argue of the Urban Water Resources Centre at the University of South Australia has undertaken extensive research on the siltation of blocks and laying course. His research assumed rainfall of 580mm per annum with a loading of 200 parts per million of silts. This is similar to the annual rainfall in Newark, Nottinghamshire, and the silt loading is what would be found in an established urban catchment.

He concluded that after 35 years, surface permeability is approximately 20% of the 'as new' value.

Assuming a 'worse case scenario' where after say twenty five years, 90% of the surface permeability has been lost through silting. The permeability of the surface is still 9000mm x 10% or 900mm of water per hour per m^2 (900 litres per m^2). This would indicate that the surface permeability is still eighteen times what is required to deal with 50mm of rain in an hour.

continued overleaf



testing undertaken by The Transport Research Laboratory

Hanson Formpave design team:
01594 836999 or
designservices@formpave.co.uk

System details -
principal benefits
continued

Hanson Formpave design team:
01594 836999 or
designservices@formpave.co.uk

Heavy duty use

Trials undertaken at the Transport Research Laboratory validated the sub-base design for heavy duty use. It is recommended that this sub-base design is used wherever there is a possibility of over-run by heavy vehicles.

The heavy duty sub-base design comprises two separately graded layers of stone with an SC intergrid at the interface between the two layers (a further optional second SC intergrid may be installed lower down the sub-base at the engineers discretion).

The standard details show a base layer of 250mm of 10-63 stone overlaid by a SC intergrid and a 100mm depth layer of 5-20 stone. The depth of the sub-base may be varied at the engineers discretion.

In certain circumstances it may be necessary to include a Dense Bitumen Macadam (DBM) layer beneath the laying course, this should be punctured at 800mm centres.

Design criteria

The sub-base has a reservoir capacity of approximately 30%. As a quick rule of thumb - 10m^2 of Formpave Aquaflow system with a depth of 350mm of sub-base will accommodate 1 cubic metre of water.

Where it is proposed to drain impermeable surfaces onto areas of Aquaflow it is recommended that a maximum ratio of 2:1 impermeable: Aquaflow is used.

Excessive run-off from an impermeable surface onto an Aquaflow area could result in siltation occurring and increase the requirement for regular maintenance.

Design service

Formpave offer a comprehensive free design service to suit individual site requirements.

The service offered by Formpave's team of engineers includes technical and professional advice, preparation of draft proposals, and validation of client's own designs.

All designs that have been provided or approved by Hanson Formpave are covered by Formpave's professional indemnity insurance and benefit from the company's 15 years experience in designing permeable paving systems.

Every aspect of Formpave's permeable paving system has been independently tested and verified - both in terms of pollution control properties and hydraulic and structural performance. During the past 15 years the Company has sponsored an ongoing programme of research and development into permeable paving systems at a number of academic and independent institutions including Coventry University, Edinburgh University, Abertay University, Delft University, HR Wallingford, University of Cantabria and TRL at Crowthorne.

Formpave have always shared (and continue to share) the results of this research with the construction industry, and it is this approach that has established the Company as the world leader in permeable paving solutions.

All drawings provided by Hanson Formpave are protected by Copyright and Design rights and should not be duplicated without permission from the Hanson Formpave design team.

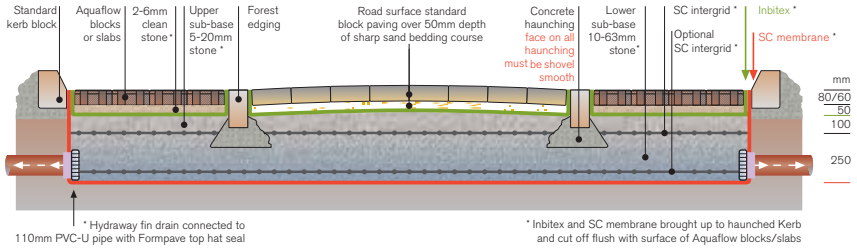
The following information can be provided by contacting the Hanson Formpave design team: Standard detail in 'AutoCAD' format also specifications for laying, reinstatement and maintenance as shown on pages 20-24.

Construction Drawings

Illustrations on this page feature the Tanked system for Infiltration replace SC membrane with Inbitex. For further information contact the Hanson Formpave design team.

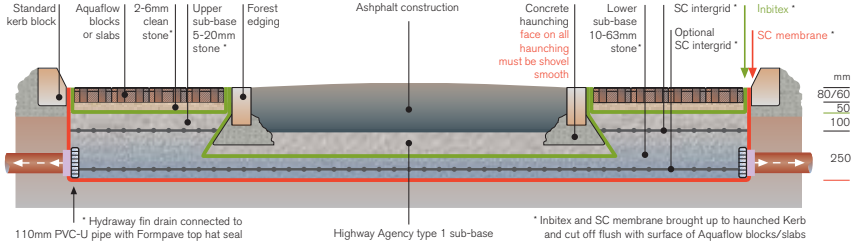
Aquaflow paving in conjunction with standard block paved road surfaces

Tanked system section Aquaflow pavement with undersealing membrane



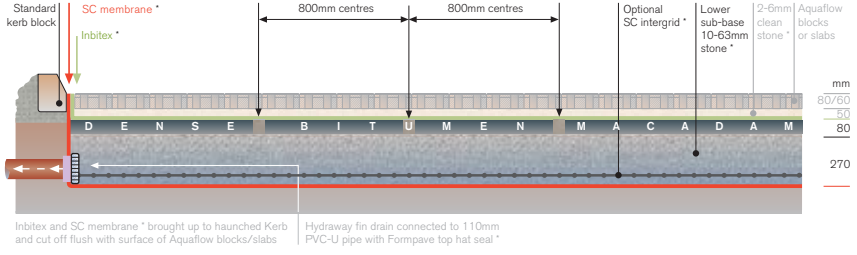
Aquaflow paving in conjunction with asphalt road surfaces

Tanked system section Aquaflow pavement with undersealing membrane



Construction running surface - adoptable design

Tanked system section Aquaflow pavement with undersealing membrane



Hanson Formpave design team:
01594 836999 or
designservices@formpave.co.uk

- Lay SC membrane, optional intergrid, 270mm of sub-base and SC intergrid
- Lay 80mm of dense base course Dense Bitumen Macadam (DBM) over sub-base (see specification)

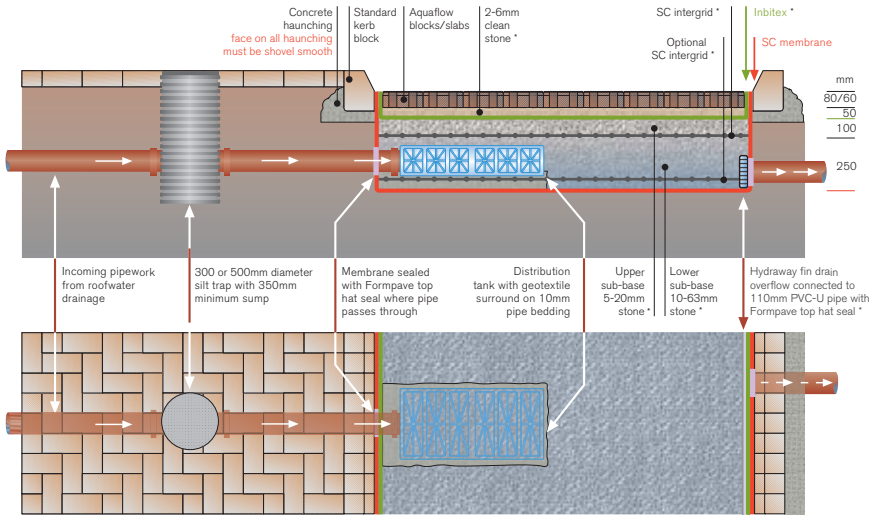
After building work is completed

- Clean Dense Bitumen Macadam (DBM) surface
- Cut 20/50mm diameter holes at 800mm centres through DBM surface into sub-base
- Fill holes with 2-6mm clean stone
- Lay Inbitex, 50mm laying course and Aquaflow blocks or slabs

• See specifications

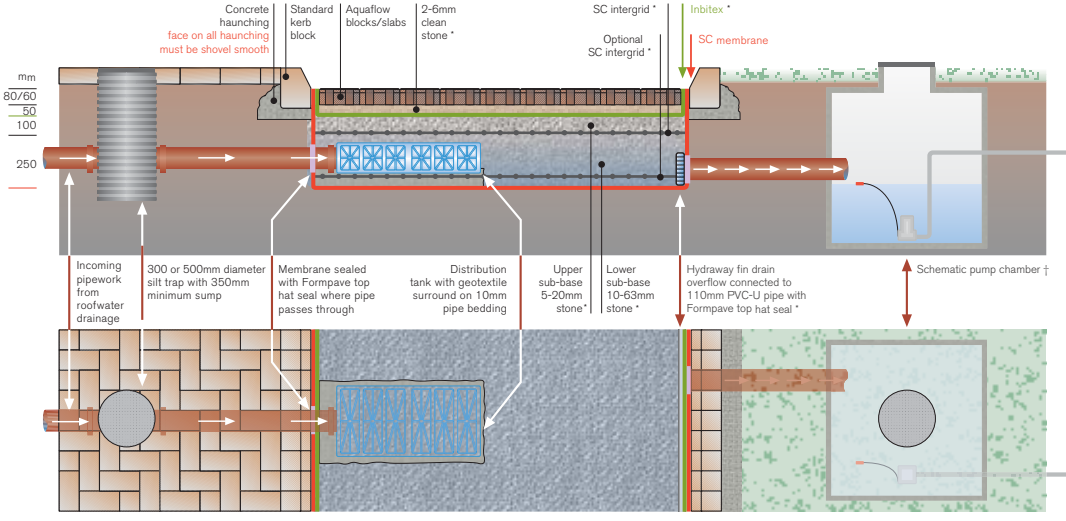
Down pipe drainage into tanked system

Aquaflow pavement with undersealing membrane



Aquaflow paving in conjunction with water harvesting drainage system

Shown with the Standard Tanked system

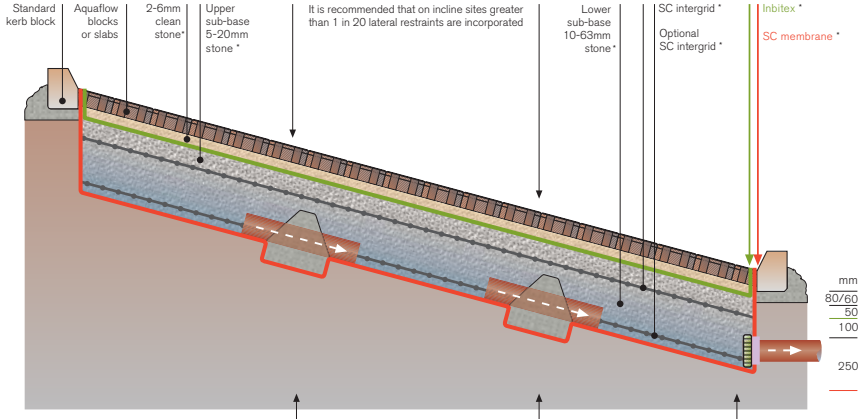


• See specifications

Illustrations on this page feature the Tanked system for Infiltration replace SC membrane with Inbitex. For further information contact the Hanson Formpave design team.

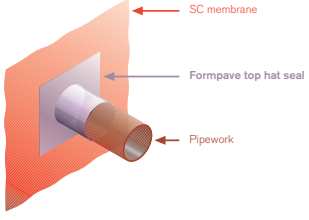
Sloping sites tanked system

Aquaflow pavement with undersealing membrane also see plan



Formpave top hat seal

Under normal conditions the top hat seal is taped to the SC membrane. Where methane or a high water table is present a fully welded seal is required and specialist advice should be sought prior to installation.



Distribution Tanks

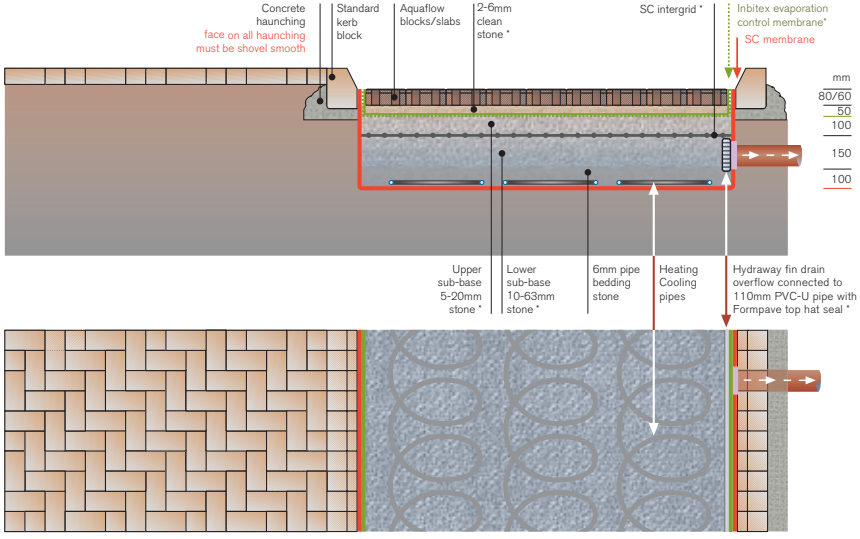
For use in association with down pipe drainage into a tanked system

Hanson Formpave design team:
01594 836999 or
designservices@formpave.co.uk

* See specifications

Aquaflow paving in conjunction with Geothermal heat transfer

Shown with the Standard Tanked system



Loops set in the sub-base

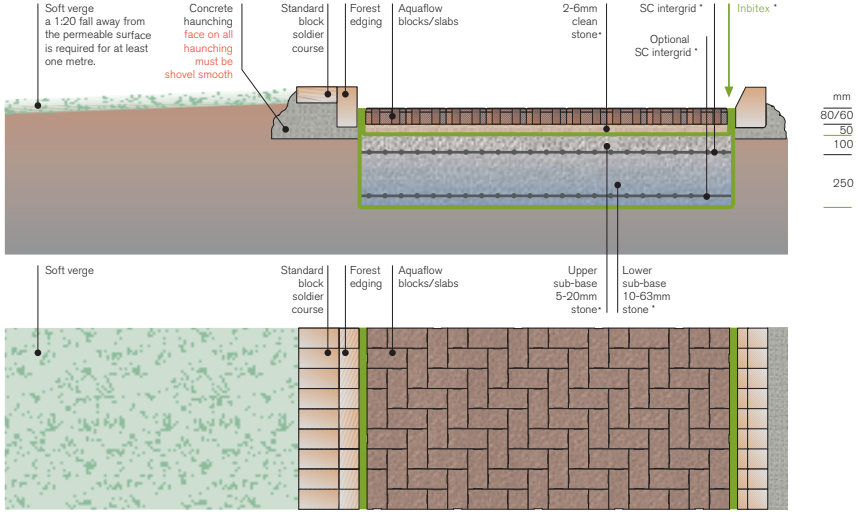
Heating
The heat pump reverses its operation, extracting heat from the earth and delivering it to the building's HVAC system.

Cooling
Heat is extracted from the building and transferred by the heat pump circulating through the ground loop.

As water circulates, it gives up this heat into the cooler earth. The cooled water then returns to the heat pump to pick up more heat.

Soft landscaping and Aquaflow paving

Recommended detail shown with infiltration system



* See specifications

Standard contract documentation
To be read with preliminaries/ general conditions

Q24 SUSTAINABLE URBAN DRAINAGE SYSTEM
Aquaflow paving

115 TYPE(S) OF PAVING
Permeable concrete block paving

Manufacturer:
Hanson Formpave
Tufthorn Avenue, Coleford
Gloucestershire, GL16 8PR
t 01594 836999
f 01594 810577

e-mail:
designservices@formpave.co.uk
technical@formpave.co.uk
sales@formpave.co.uk

web-site: www.formpave.co.uk

Reference
Aquaflow, Aquaflow ML, MLE, MLTB, Aquasett or Aquaslab.

Size
As per manufacturer's specification

Colours
Red brindle, Golden brindle, Natural, Charcoal, Burnt red. *Aquasett* available in Red brindle, Vendage, Traditional and Pennant.

Setting out
Aquaslab: Staggered stretcher bond with double stretcher course around all perimeters.

Aquasett: Staggered stretcher bond or 90° herringbone with double stretcher course around all perimeters.

Aquasett combined: Staggered stretcher bond with double stretcher course around all perimeters.

Aquaflow block: 90° herringbone with double stretcher course around all perimeters.

Aquaflow ML: Include stretcher course around edge in conjunction with MLE and MLTB.

Kerbs
Standard kerb system or Forest Edging: both to be haunched with concrete.

Laying course*
50mm depth of 2-6mm. single size clean crushed stone to BS EN 13242: 2002.

Inbitex® †
As specification

Sub-base specification*
All granular sub-base material shall comprise crushed gravel, rock or concrete possessing well defined edges. It must be sound, clean, non friable and free from clay or other deleterious matter.

The material must be non plastic when tested in accordance with BS1377 Test No.4

* The crushed stone used for the laying course and sub-base must have a minimum 10% fines value of 150kN when tested in accordance with BS812 Part 111.

The selected test samples shall not be oven dried and should be soaked in water at room temperature for 48 hours before the test.

The 100mm deep upper layer of sub-base material should be graded 5mm-20mm to BS EN 13242: 2002.

Grading of lower layer of sub-base stone:

BS EN Sieve size	% passing
80mm	100
63mm	90-100
40mm	60-80
20mm	15-30
10mm	0-5

Depth of Sub-base
It is recommended that a sub-base depth of 350mm should be used. The depth of sub-base may be varied at the discretion of the Engineer. Alternatively 270mm of sub-base overlaid with 80mm of dense bitumen base course to Clause 903 of the Highways Agency Specification may be used.

Intergrid(s) † SC Intergrid.

DBM Running Course
To be 20mm dense base binder course manufactured with 100/150 grade bitumen to BS4987. The DBM shall conform with the requirements of BS 4987.

Membrane †
Generally a taped membrane will be suitable for most applications of the tanked system. If a guaranteed watertight system is required a fully welded system should be installed. Examples of this type of application would be sites with a high water table, methane contamination, areas above basements or retaining walls. Further advice should be sought from the Hanson Formpave design team.

Fin drain †
300mm Hydraway Fin Drain to BBA Number 95/85.

Seal † Formpave top hat seal

Sub-grade *see details on page 6*
Where the structure is to be over-run by heavy vehicles the sub-grade should have, or be improved to have, a CBR of at least 15%. Poor sub-grades with low CBR's may be improved by incorporating a capping layer of cement, lime or bituminous bound materials. Alternatively granular materials in accordance with clause 613 of the Highways Agency specification may be used.

Inbitex® † and Distribution Tanks

Inbitex®
Thermally bonded nonwoven developed to optimise the cleansing of water entering the system. The various characteristics have been combined to create a unique geotextile that aids the development of the naturally occurring microbes, and offers them refuge during periods of drought.

Mechanical properties	
Wide width strip tensile	EN ISO 10319
Mean peak strength	8.50kN/m
Elongation at peak strength	28%
CBR puncture resistance	EN ISO 12236
Mean peak strength	1575N
Trapezoidal tear resistance	ASTM D4533
Mean peak strength	325N
Hydraulic properties	
Pore size	EN ISO 12956
Mean AOS O_{90}	0.145mm
Water flow	EN ISO 11058
Mean flow VI_{H50} 10-3m.s-1 (l/m^2s)	80
Water breakthrough	BS 6906: Part 3
Mean head	50mm
Air permeability	ISO 9237
Mean flow	2875 $l/m^2.s$
Typical physical properties	
Mass EN 965	130 g/m^2
Roll width	4.5 & 1.5m
Roll length	100m

Distribution Tanks
For use in association with down pipe drainage into a tanked system

Material Polypropylene, Polyethylene, PVC (connector)

Volumetric void 92 %

Effective perforated surface area 59 %

Compressive strength (1) 715 kN/m^2 (unconfined)

Compressive strength (2) 1650 kN/m^2 (confined in typical pavement,130mm cover)

Nominal size 354 x 708 x 150mm

Nominal volume 0.0375m^3

Weight 3kg

Construction

Laying generally
All construction work on pavements should be carried out following completion of general site works **and after topsoiling of adjacent areas** to prevent wash down of fine materials. Where a temporary running surface is required the construction should be in accordance with diagram on page 16.

Sub-grade
Excavate to sub-grade appropriate levels shown on site drawings to provide a minimum fall of 1:1000 to fin drain. Where it is proposed to infiltrate no falls are necessary.

The sub-grade should be compacted with a vibrating plate or roller to the requirements of Clause 613 of the Highways Agency specification. Prior to compaction all soft areas should be removed and filled with suitable replacement material to provide a stable sub-grade.

Kerbs/Edgings
The paved areas must be firmly restrained. Where the pavement is designed for heavy use the concrete kerb haunching must extend to a minimum depth of 150mm below the base of the kerb.

The kerb/edging must extend with sufficient height above the haunching to accommodate the full laying course depth and block height.

SC Membrane
Lay SC membrane taking care to overlap the joints by 300mm using double sided tape. Where site conditions dictate that a water-tight system is required a fully welded membrane will be necessary, specialist advice should be sought prior to installation. If it is proposed to drain by infiltration to the sub-grade, the SC membrane should be replaced with a geotextile to stop the ingress of sub-grade material into the sub-base. The fin drain will not be required for infiltration designs.

Sub-base
The lower layer of sub-base (10-63mm) should be placed in 2 separate layers, each layer being compacted with a vibrating roller or heavy duty vibrating plate to the requirements of Clause 802 of the Highways Agency specification. The final pass should be undertaken with no vibration. Compaction should continue until 97% of the compacted bulk density achievable under laboratory conditions has been reached. This can be measured with a nuclear density gauge. The specified 350mm depth of sub-base may be varied by the Engineer to suit site requirements.

SC Intergrid
Where required the Intergrid should be incorporated at the interface between the two layers of sub-base. The Intergrid should be laid on the sub-base and joints should be overlapped by 300mm.

The upper sub-base layer (5-20mm) should then be laid on top of the Intergrid and compacted as before.

A second intergrid can be incorporated underneath or within the sub-base at the engineers discretion. This should be laid in the same way as the first intergrid.

Inbitex®
Lay geotextile on top of the sub-base overlapping joints by 300mm. Inbitex should be brought up to the haunched kerb/edging and cut-off flush with the surface of the paving.

Laying course
Lay and screed to level approximately 50mm depth of 2-6mm single sized crushed stone to BS EN 13242: 2002. It is important that the final level of the 2-6mm stone is accurate as the stone will compact down much less than sand when the surface blocks are vibrated. The particle shape of

continued overleaf

Aggregates are available through:

Hanson

Hanson Aggregates
for further information phone
Formpave sales office
01594 836999

† supplied by:

Geosynthetics Limited
telephone 01455 617139
fax 01455 617140
e-mail sales@geosyn.co.uk
www.geosyn.co.uk

telephone 0117 941 5480
fax 0845 609 2525
e-mail geotechnics@wtbgroup.com
www.geotechnics-uk.com

the 2-6mm stone will also affect the degree of compaction.
It is recommended that a small trial area should be laid prior to construction to determine the accuracy of final levels.

Block laying
It is advisable to pre-set the block level by 6mm to allow for the effects of settlement when laid against fixed edgings. The blocks and slabs must be tightly butt jointed ensuring that a good fit is achieved.

A single or double stretcher course of Aquaflow blocks must be used around the periphery of the paved areas and also at the edges of any separately restrained areas, such as tree pits.

It is recommended that lateral restraints (such as forest edging) should be installed in areas where vehicles turn and/or brake, such as bends and junctions and on large areas of paving. The lateral restraints should be properly constructed and haunched with concrete.

Where blocks need cutting, they should be cut to a tight fit and none are to be smaller than 30% of the unit block size with three machined edges. Where Aquaflow blocks are cut they must be cut across the 100mm and not the 200mm dimension. Blocks should be cut vertically and not under-scored. All block cutting should be carried out with a disc cutter.

Surface Finish
The blocks should be vibrated with a vibrating plate Type DVP75/22" or similar. Following the first pass with a vibrating plate, 2-4mm clean quartzite or gritstone should be applied to the surface and brushed in. (Available from Formpave in 25 kg bags).
The tapers and slots between the blocks should be fully filled. Blocks should again be vibrated and any debris brushed off.

Method of accessing services and reinstatement

General
It is important that access to services in or underneath the Formpave Sustainable urban drainage system is undertaken in a disciplined and progressive way.

Procedure
Uplift Aquaflow blocks 1m either side of the line of relevant underground services.

Take up the laying course stone and cut the underlying geotextile membrane along either side of the line of services and parallel with them. Dispose of the laying course stone and geotextile.

Excavate sub-base stone and place adjacent to the excavation on plastic membrane. The sub-base stone can be re-used.

Cut intergrid(s) in the same way as the geotextile and dispose of it.

Cut layer of geotextile or waterproof membrane at reduced level along the line of the services in the same way as the higher layer of geotextile and dispose of it.

Excavate material over and around services and put on plastic membrane ready for re-use.

Carry out repair on services.

Once repairs have been completed replace and fully compact the excavated material around the services.

Cut fresh geotextile or waterproof membrane to size allowing additional 300mm extra width either side of the remaining geotextile membrane. Tape new geotextile/membrane in place.

If a heavy duty welded waterproof membrane is installed due to a high water table or the presence of methane the replacement membrane will need to be rewelded to the existing membrane.

Replace the first 250mm depth of sub-base and thoroughly compact, cut and install fresh intergrid(s) allowing 300mm of extra width either side.

Spread and compact final 100mm depth of sub-base.

Cut fresh geotextile membrane to size again allowing 300mm overlap using double sided tape.

Lay and loose screed to level approximately 50mm depth of 2-6mm crushed stone to BS EN 13242: 2002.

Replace surface blocks, vibrate surface blocks to level and dress the surface with 2-4mm clean gritstone and vibrate again.

Brush off and dispose of any debris before final vibration.

Colours and finishes

Colour and finish variation
Hanson Formpave products are manufactured from naturally occurring materials and consequently may show slight variations in finish and colour.

It is strongly recommended that products are taken from two or more packs and mixed during laying to minimise any colour variation.

All concrete products may suffer from efflorescence. This occurs naturally and will disappear with use. It is in no way detrimental to the performance of the product. No responsibility can be accepted for this natural reaction.

Alternative colours & finishes
Special colours and finishes are available to order. Please contact sales office details.

Samples
Sample blocks are available from your nearest Hanson Formpave Stockist upon request.

Charcoal *Aquaflow and Aquaslab*

Burnt Red *Aquaflow and Aquaslab*

Golden Brindle *Aquaflow and Aquaslab*

Natural *Aquaflow and Aquaslab*

Red Brindle *Aquaflow, Aquaslab and Aquasett*

Traditional *Aquasett*

Vendage *Aquasett*

Pennant *Aquasett*

EcoGranite *Aquasett, Aquaslab and Aquaflow*
Not available in Aquaflow ML, MLE or MLTB

Standard finish

Olden finish

Bush hammered finish

Standard finish
Aquaslab
Aquaflow blocks
Aquaflow ML
Aquaflow MLE
Aquaflow MLTB

Olden finish
Aquasett
Aquasett combined

Bush hammered finish
to special order
Aquasett
Aquaslab
Aquaflow blocks

Colour reproduction
Every care has been taken to reproduce the colour of the blocks in this brochure as accurately as possible. However, we cannot guarantee the exact colour reproduction.

Pack sizes and weights

All packs are palletised and shrink wrapped with the exception of the Aquaflow block which is Void packed.

60mm Aquaslab 11.34m² per pack, 84 blocks in 14 layers. Weight approximately 1.49 tonnes per pack.

60mm Aquasett 10.5m² per pack, 280 blocks in 14 layers. Weight approximately 1.38 tonnes per pack.

80mm Aquasett 7.50m² per pack, 200 blocks in 10 layers. Weight approximately 1.33 tonnes per pack.

60mm Aquasett combined 11.2m² per pack, 434 blocks in 14 layers. Weight approximately 1.47 tonnes per pack.

80mm Aquasett combined 8.0m² per pack, 310 blocks in 10 layers. Weight approximately 1.42 tonnes per pack.

60mm Aquaflow block 8.48m² per pack, 424 blocks in 14 layers. Weight approximately 1.10 tonnes per pack.

80mm Aquaflow block 5.92m² per pack, 296 blocks in 10 layers. Weight approximately 1.04 tonnes per pack.

80mm Aquaflow EcoGranite block 8.0m² per pack, 400 blocks in 10 layers. Weight approximately 1.42 tonnes per pack.

80mm Aquaflow ML block 6.5m² per pack, 250 blocks in 10 layers. Weight approximately 1.15 tonnes per pack.

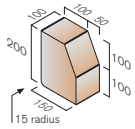
80mm Aquaflow MLE block 52 lm per pack, 300 blocks in 10 layers. Weight approximately 1.22 tonnes per pack.

80mm Aquaflow MLTB block 80 lm per pack, 400 blocks in 10 layers. Weight approximately 1.04 tonnes per pack.

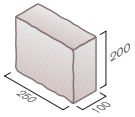
Formpave kerb options

The range of kerb options together with the full range of Formpave concrete paving products are illustrated in greater detail in the standard Formpave manual available on request.

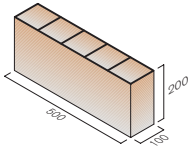
Standard kerb system
The range consists of fifteen blocks to facilitate edge restraint, cornering, cross-over and transition.



EcoGranite kerb
Bush hammered finish.



Forest edging
A substantial edge restraint also used for lateral strength in pavement design.



Maintenance

The surface blocks have a design life equivalent to standard block paving.

All paved surfaces will require occasional cleaning. In normal circumstances, regular sweeping will be sufficient.

It is recommended that this should be carried out in the spring and after leaf fall in autumn.

It should be noted that lighter coloured blocks may exhibit tyre marks and will therefore require more cleaning and maintenance when used in certain situations.

Following routine maintenance it may be necessary to re-dress the surface with 2-4mm clean gritstone.

Ultimately, perhaps after 25 years or more, areas of the laying course may become filled with silts and toxins. If this occurs the surface blocks should be uplifted and the affected areas of laying course material and geotextile disposed of. The existing sub-base can be left in situ. Fresh geotextile and laying course stone should be installed and the existing surface blocks re-used.

Patents

Hanson Formpave
Tufthorn Avenue
Coleford
Gloucestershire
GL16 8PR
tel 01594 836999
fax 01594 810577

designservices@formpave.co.uk
technical@formpave.co.uk
sales@formpave.co.uk

www.formpave.co.uk

The system and products described in this brochure are covered by patents and patent applications in Great Britain and other countries:

GB 2 294 077
GB 2 338 969
AU 42815/99
CA 2 334 571
EP 99942636.4
US 09/719,256
NZ 508 786
SG 77889
AU 2002217305
CA 2431 629
EP 1274092.4
NZ 526311
SG 200303346-1
US 10/450,764
ZA 2003/4637
GB 0406776.5
GB 99/01555
GB 99/01552

Formpave's policy of continuous product development may necessitate changes to specifications without prior notification.

All drawings shown within this brochure are indicative only and not to scale.

All drawings and text are covered by copyright and may not be reproduced or transmitted in any form without prior consent from Hanson Formpave.

© 2007
Hanson Formpave
Coleford, England, UK.

Hanson Formpave

Tufthorn Avenue
Coleford
Gloucestershire
GL16 8PR
tel 01594 836999
fax 01594 810577

designservices@formpave.co.uk
sales@formpave.co.uk

www.formpave.co.uk

Hanson

Hanson Plc a Global Business
Hanson is one of the world's largest suppliers of heavy building materials to the construction industry, with a turnover in 2006 of £4.1bn. Our products fall into two categories: Aggregates (crushed rock, sand and gravel, ready-mix concrete, asphalt and cement related products) and Building Products (clay bricks, pre-cast products and concrete pavers, blocks, tiles and pipes). We employ 26,000 people, operating primarily in North America, the UK and Australia with further operations in Asia Pacific and Continental Europe. Hanson Building Products UK incorporates London Brick, Thermalite, Red Bank, Cradley and Formpave.

Printed on Hello Matt using totally chlorine Free (TCF) pulps from sustainable forests. Design Tony Baldaro FSCD

FM 12515

BBA BRITISH BOARD OF AGREMENT