

All transition kerbs are sold in pairs, left and right handed.

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Standard contract documentation
*To be read with preliminaries/
general conditions*

Q24 SUSTAINABLE URBAN DRAINAGE SYSTEM

Aquaflo 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

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

web-site: www.formpave.co.uk

Reference

Aquaflo, Aquaflo ML45, Aquasett,
Aquasett combined, Aquaslab, and
Aquaflo ML, MLE, MLTB.

Size

As per manufacturer's specification

Colours

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

All products available in EcoGranite
except Aquaflo ML, MLE, MLTB.

Setting out

Aquaflo and Aquapave blocks:
recommended 90° herringbone
with double stretcher course
around all perimeters.

Aquaflo ML45: 45° herringbone
as palletted, 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.

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

Aquaflo 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 size
clean crushed stone to BS EN
13242: 2002.

Inbitex* geotextile
As specification

Sub-base specification*

All granular sub-base material
shall comprise crushed clean stone,
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 for an
adoptable road scheme use a
450mm sub-base with a 80mm
dense bitumen base course to
Clause 903 of the Highways
Agency specification.
(see diagram on page 16)

Intergrid(s) SC Intergrid geogrid

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.

SC Membrane geomembrane

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 geomembrane
application would be geothermal
projects, sites with a high water
table, methane contamination and
areas above basements or
retaining walls. Further advice
should be sought from the
Hanson Formpave design team.

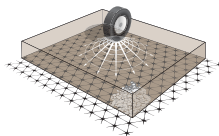
Fin drain

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

Seal Formpave top hat seal

Sub-grade

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.



Thermally bonded nonwoven developed to optimise the cleaning 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 D_{90}	0.145mm
Water flow	EN ISO 11058
Mean flow V_{150} 10.3m.s.1 (l/m ² .s)	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

The unique structure of the SC Intergrid incorporates several characteristics which out-perform conventional biaxial geogrids in traffic applications.



Load distribution
Load distribution is 3-dimensional in nature and acts radially at all levels in the aggregate. For a stabilised layer to be effective it must have the ability to distribute load through 360 degrees.

Multi-directional properties
The SC Intergrid has three principal directions of stiffness, which is further enhanced by their trigonular geometry. This produces a significantly different structure than any other geogrid and provides high stiffness through 360 degrees.

A truly multi-directional product with near isotropic properties.

Junction integrity & efficiency
The SC Intergrid is produced from an extruded sheet of polypropylene. This is then punched and stretched to create the unique structure, which coupled with the design of the junctions results in a product with high junction strength and stiffness.

Testing has been conducted in line with each of the three rib directions. The junction strength was found to be essentially equal to the rib strength - giving a junction efficiency of 100%.

Greater interlock and confinement

In a mechanically stabilised layer, aggregate particles interlock within the geogrid and are confined within the apertures, creating an enhanced composite material with improved performance characteristics. The shape and thickness of the geogrid ribs and the overall structure of SC Intergrid has a direct influence on the degree of confinement and efficiency of the stabilised layer.

Proving the importance of rib profile

SC Intergrids have greater rib depth compared with conventional biaxial geogrids. Traffic tests and analytical modelling were undertaken to compare performance advantages between the biaxial and SC Intergrid in a mechanically stabilised layer. The results were conclusive in confirming that an improved structural performance was achieved with the SC Intergrid design.

Sustainable design

The improved performance of SC Intergrid enables greater reduction in aggregate layer thickness, further reducing the quantities of natural aggregates used and the volume of material to be excavated. These additional savings in materials and transport will help engineers to meet their sustainability objectives.

A number of tests and trials have been conducted and prove the performance benefits of the SC Intergrid. Tests included traffic trials at the University of Nottingham and, on a large scale, at the Transport Research Laboratory (TRL). Installation damage assessment, bearing capacity and field tests were also conducted as part of the comprehensive and rigorous testing programme.

- High resistance to puncture
- Restricts water entering the sub-grade
- Preserves sub-grade structural integrity
- Tape bonded or welded joints
- Manufactured in the UK

Description

Aquaflow SC Membrane is a UK manufactured co-polymer thermoplastic membrane. The product is coloured green, 500 microns thick (2000 gauge) and supplied in rolls 4m x 12.5m.

Application

Aquaflow SC Membrane provides an impervious layer ensuring attenuation of the collected storm water. It restricts water entering the sub-grade and preserves sub-grade structural integrity.

For watertight situations Geothermal/Water Harvesting a heavier welded membrane will be needed, for further details contact design services. designservices@formpave.co.uk

Covering

The membrane should be covered as soon as possible after installation. Care should be taken to ensure that the membrane is not punctured, stretched or displaced when applying the sub-base.

Storage and handling

Aquaflow SC Membrane is classified as non-hazardous when used in accordance with the manufacturers' instructions. The membrane is chemically inert and is not affected by acids or alkalis that may be present in the sub-base or sub-grade. The product is not intended for use where it will be exposed for long periods of outdoor weathering.

When the weather is cold, Aquaflow SC double sided jointing tape should be kept in a warm, dry place until needed. Membrane installation is not recommended below 5°C.

Technical Data

Aquaflow SC Membrane	
Thickness	500 microns (2000 gauge)
Colour	Green
Roll dimensions	4m x 12.5m
Roll weight	23kg
Resistance to water pressure - taped joint	24 hours @ 60kPa Pass 2 hours @ 240kPa Pass

Aquaflow SC double sided jointing tape

Thickness	1.5mm
Colour	Black
Roll dimensions	100mm x 15m

The values given are indicative and correspond to typical results obtained in laboratories and testing institutes.

Fin Drain
Top hat seal



Triple distribution tank

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 % (unconfined)

Compressive strength (1) 715 kN/m² (unconfined)

Compressive strength (2) 1650 kN/m² (confined in typical pavement, 130mm cover)

Nominal size
single 354 x 708 x 150mm
double 708 x 708 x 150mm
triple 1062 x 708 x 150mm

Nominal volume
single 0.0375m³
double 0.075m³
triple 0.1125m³

Weight
single 3kg
double 6kg
triple 9kg

Fin Drain
The fin drain has a minimum permeable surface of 75%. This allows rapid removal of water through all faces and the clog resistance of the geotextile ensures that the system remains silt free. Fin drain has crushing strengths in excess of 600kN/m² and is manufactured from polymers resistant to degradation by common chemicals, acids, alkalis and bacteria.

Top hat seal
Pre-formed seal to be slipped around the outlet pipe to form a watertight seal with the SC Membrane tanking.

Hanson Formpave have established relationships with key suppliers of the component parts of the system to ensure that the highest quality products are readily available for customers installing the system. All of the aggregates and geotechnical products meet Hanson Formpave's strict specification requirements, therefore giving the customer peace of mind that they are using approved products.

cool planet
Geothermal partner specialists in renewable energy. www.cool-planet.co.uk

TERRAM
Manufacturers of Inbitex

VISQUEEN
Manufacturers of SC Membrane

Tensar
Manufacturers of SC Intergrid



Aggregates are available through:

Hanson HEIDELBERG CEMENT Group
Hanson Aggregates
For further information phone: [01984 839999](tel:+441984839999)
Formpave sales office 01984 839999

Sub-base stone specification



Surface dressing grit
Surface dressing grit 2-4mm,
clean quartzite.

Surface Dressing

2-4mm quartzite/gritstone

Scope

This specification defines the 2-4mm surface dressing to be applied to the surface of Aquaflow pavers and subsequently brushed/vibrated between pavers.

Reference specifications

BS EN 1097-2:1998

BS EN 1091-8:2000 Annex A

Material specification

Material supplied shall be referred to as 2-4mm Clean Quartzite and conform to the following sieve analysis and aggregate testing.

BS EN sieve size % passing

6.3mm	100
5mm	95-100
3.35mm	66-90
1.18mm	0-20
600 microns	0-8
63 microns	0.0-1.5

Upper layer
100mm depth 5mm-20mm clean, crushed with well defined edges
BS EN 13242:2002

Aggregate Testing

Los Angeles coefficient (LA) - determination of resistance to fragmentation = 20
BS EN 1097-2:1998

Aggregate abrasion value - determination of resistance to abrasion = 21

BS EN 1091-8:2000 - annex A

Note: Lower values than those specified signifies better resistance to fragmentation and abrasion and is therefore acceptable.

Approved supplier list

Where possible suppliers should be registered to BS EN ISO 9000. Please contact the Formpave sales office for current list.

Laying Course

2-6mm clean crushed stone

Scope

This specification defines the 2-6mm laying course.

Reference specifications

BS EN 13242:2002

Material specification

Material supplied shall be referred to as 2-6mm clean crushed stone and conform to the following sieve analysis and aggregate testing.

BS EN sieve size % passing

10 mm	98-100
6.3mm	80-100
2mm	0-20
1mm	0-5

Aggregate Testing

Los Angeles coefficient (LA) - determination of resistance to fragmentation = 20
BS EN 1097-2:1998

Aggregate abrasion value - determination of resistance to abrasion = 5

BS EN 1091-8:2000- annex A

Note: Lower values than those specified signifies better resistance to fragmentation and abrasion and is therefore acceptable.

Approved supplier list

Where possible suppliers should be registered to BS EN ISO 9000. Please contact the Formpave sales office for current list.

Upper Sub-base

5-20mm clean crushed stone

Scope

This specification defines the 5-20mm upper sub-base.

Reference specifications

BS EN 13242:2002

Material specification

Material supplied shall be referred to as 5-20mm clean crushed stone and conform to the following sieve analysis and aggregate testing.

BS EN sieve size % passing

40mm	100
20mm	90-100
10mm	25-70
4mm	0-15
2mm	0-5

Aggregate Testing

Los Angeles coefficient (LA) - determination of resistance to fragmentation = 20
BS EN 1097-2:1998

Aggregate abrasion value - determination of resistance to abrasion = 5

BS EN 1091-8:2000- annex A

Note: Lower values than those specified signifies better resistance to fragmentation and abrasion and is therefore acceptable.

Approved supplier list

Where possible suppliers should be registered to BS EN ISO 9000. Please contact the Formpave sales office for current list.

Lower Sub-base

10-63mm clean crushed stone

Scope

This specification defines the 10-63mm lower sub-base.

Reference specifications

BS EN 13242:2002

Material specification

Material supplied shall be referred to as 10-63mm clean crushed stone and conform to the following sieve analysis and aggregate testing.

BS EN sieve size % passing

100mm	100
63mm	90-100
40mm	60-80
20mm	15-30
10mm	0-5

Aggregate Testing

Los Angeles coefficient (LA) - determination of resistance to fragmentation = 20
BS EN 1097-2:1998

Aggregate abrasion value - determination of resistance to abrasion = 5

BS EN 1091-8:2000- annex A

Note: Lower values than those specified signifies better resistance to fragmentation and abrasion and is therefore acceptable.

Approved supplier list

Where possible suppliers should be registered to BS EN ISO 9000. Please contact the Formpave sales office for current list.

Maintenance and performance guidelines

Product	Function	Guarantee/life expectancy	Maintenance
SC Membrane	Forms tank to contain the sub-base and water	25 years	No maintenance required
Inbitex	Removes Heavy metals and Hydrocarbons	25 years	No maintenance required
SC Intergrid	Reduces sub-base depth by stabilising the granular material	25 years	No maintenance required
Crushed stone			
10-63mm	Sub-base	Life	No maintenance required
5-20mm	Regulating Sub-base	Life	No maintenance required
63mm	Laying course	Life	No maintenance required
Gritstone 2-4mm	Surface Dressing	25 years	Top-up after cleaning
Fin drain	To enhance water flow to outlet pipe	25 years	No maintenance
Top hat seal	To Form a seal around incoming/outlet pipes	25 years	No maintenance
Distribution tanks	To enhance and diffuse the water flow into the sub-base aggregate	25 years	No maintenance
Aquaflow paving	Surface finish allowing water to pass through into the sub-base	20 years	Brush surface blocks at least twice a year

If designed by Hanson Formpave Design Services the project will be covered by our Professional Indemnity Insurance for 12 years.

Further details can be obtained from our web site or from the Formpave sales office.

Cleaning

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 silt 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.



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. All soft areas should be removed and filled with suitable replacement material to provide a stable sub-grade.

The sub-grade should be compacted with a vibrating plate or roller to the requirements of clause 613 of the Highways agency specification.

Aquaflow SC Membrane[®]

- Must be watertight - a taped joint will be insufficient.
- Joints should be fully welded.
- Can be completed on site or pre-formed off site and delivered ready for installation.
- Must be brought up to the haunched kerb/edging and cut-off flush with the surface of the paving.

Membrane jointing

For most application, tape-bonded joints are suitable. However, in applications where a high level of waterproofing integrity is required, such as sites with high water tables or areas above basement structures, the membrane should be laid with welded joints.

Taped joints

Ensure that the membrane is clean and dry at the time of jointing. The membrane should be overlapped by at least 300mm and bonded with Aquaflow SC double sided jointing tape positioned approximately 50mm into the overlap. Pressure should be applied to the bonded area of the lap to ensure waterproofing integrity.

Perforations or punctures in the membrane should be covered with another sheet of membrane, have an overlap of at least 300mm and the laps sealed with Aquaflow SC double sided jointing tape.

Welded joints

Specialist advice should be sought prior to installation. For details of contractors who undertake on-site welding of Aquaflow SC Membrane, contact Hanson Formpave design team on 01594 836999.

Covering

The membrane should be covered as soon as possible after installation. Care should be taken to ensure that the membrane is not punctured, stretched or displaced when applying the sub-base.

Storage and handling

Aquaflow SC Membrane is classified as non-hazardous when used in accordance with the manufacturers' instructions. The membrane is chemically inert and is not affected by acids or alkalis that may be present in the sub-base or sub-grade.

The product is not intended for use where it will be exposed for long periods of outdoor weathering.

When the weather is cold, Aquaflow SC double sided jointing tape should be kept in a warm, dry place until needed. *Membrane installation is not recommended below 5°C*

Sub-base

Lower layer of sub-base 10-63mm
Upper layer of sub-base 5-20mm

- Placed in 2 separate layers
- Vibrate each layer to compact
- Final pass taken with no vibration
- Compaction should continue until 97% of the compacted bulk density achievable under laboratory conditions has been reached-measured with a nuclear density gauge.

Compacted with a vibrating roller or heavy duty vibrating plate to the requirements of Clause 802 of the Highways Agency specification.

The specified 350mm depth of sub-base may be varied by the Engineer to suit site requirements.

SC Intergrid

- Lay within the sub-base and joints should be overlapped by 300mm.
- A second SC Intergrid can be incorporated underneath or within the sub-base at the engineer's discretion and 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 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

- 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.
- Single or double stretcher course of Aquaflow blocks must be used around the periphery of the paved areas.
- It is recommended that lateral restraints (such as forest edging) should be installed in areas where vehicles turn and/or brake.
- The lateral restraints should be properly constructed and haunched with concrete.

Cutting block

- Cut to a tight fit with none smaller than 30% of the unit block size with three machined edges.
- 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.

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.

Surface Finish

- The blocks should be vibrated with a vibrating plate Type DVP75/22[®] or similar.
- 2-4mm clean quartzite or gritstone should be applied to the surface and brushed in. 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.

The information given in this specification is based on data and knowledge correct at the time of printing.

Statements made are of a general nature and are not intended to apply to any use or application outside any referred to in the specification. As conditions of usage and installation are beyond our control we do not warrant performance obtained but strongly recommend that our installation guidelines and the relevant British Standard Codes of Practice are adhered to. Please contact us if you are in any doubt as to the suitability of application.

Product development
The designs shown in this brochure are illustrative only. Every effort is made to ensure the accuracy of all textual and pictorial content in this brochure.

Hanson Formpave reserves the right to change specifications without prior notice. All Hanson Formpave paving products are backed by BS EN 150 9001 certification for product quality and service.

Many water quality variables have been examined in Aquaflow paving, most produced during independent research by UK and overseas universities funded by Hanson Formpave.

This data is vital in determining the safety of the rainwater for use both chemically and microbiologically. The table shows the main chemical and microbiological contaminants that have been screened for in Aquaflow water.

Also present is information on the authority producing the data and information on when it was produced.

As can be seen from the data, Aquaflow water quality has been intensively analysed by third party organisations. Although the water quality variables do not all meet drinking water standards, all are in line with surface water discharge standards. The results also were derived using only a geotextile in the upper layers of paving with no further treatment.

To use the water in washing machines or for other domestic purposes, in line treatment such as filtration is recommended to remove suspended particles and some secondary water treatment such as UV sterilisation.

Research Authority	Contaminant	Concentration	Analysis method	
Coventry University 2008	Metals			
	Aluminium	0.100 mg/l	ICP-OES	
	Arsenic	0.002 mg/l	ICP-OES	
	Boron	Not detected	ICP-OES	
	Cadmium	Not detected	ICP-OES	
	Calcium	26.01 mg/l	ICP-OES	
	Copper	0.007 mg/l	ICP-OES	
	Iron	0.072 mg/l	ICP-OES	
	Lead	0.001 mg/l	ICP-OES	
	Lithium	0.008 mg/l	ICP-OES	
	Magnesium	1.720 mg/l	ICP-OES	
	Molybdenum	0.004 mg/l	ICP-OES	
	Nickel	0.002 mg/l	ICP-OES	
	Potassium	6.210 mg/l	ICP-OES	
	Sodium	26.01 mg/l	ICP-OES	
	Vanadium	0.013 mg/l	ICP-OES	
	Zinc	0.007 mg/l	ICP-OES	
	Edinburgh University 2007 Severn Trent Laboratories 2008 Edinburgh University 2007	Organics, nutrients and others		
		Ammonia	≤1.0 mg/l	Palintest kit
Benzene		Undetectable	HPLC	
BOD		0.4-1.0 mg/l	BOD reactor	
Dissolved oxygen		75-78 mg/l	O ₂ meter	
Electrical conductivity		≤350S	EC meter	
Ethylbenzene		Undetectable	HPLC	
Nitrate		≤5.50 mg/l	Palintest kit	
Nitrate and Nitrite		≤10 mg/l	Palintest kit	
Oil and grease		≤1.0 mg/l	Solvent extraction	
pH		6.3-8.4	pH meter	
Phosphates		≤0.42 mg/l	Palintest kit	
Sulphates		≤ 5.0 mg/l	Titration	
Suspended solids		≤100 mg/l	Filtration	
Toluene		Undetectable	HPLC	
Total dissolved solids		≤200 mg/l	Filtration evaporation	
Xylene		Undetectable	HPLC	
Coventry University 2006/08 Edinburgh University 2007 Severn Trent Laboratories 2008 Edinburgh University 2007		Microbes	Concentration (organisms per ml of pavement water)	
		<i>Acanthamoeba</i>	0-5 /ml	Microscopy
	<i>E. coli</i>	< 1 /ml	Selective media	
	<i>Enterococci</i>	< 1 /ml	Selective media	
	<i>Heterotrophs</i>	78 /ml	Selective media	
	<i>Legionellae</i> 3 key species	Undetectable	Selective media	
	<i>Salmonellae & Shigellae</i>	< 1 /ml	Selective media	
	Edinburgh University 2007			

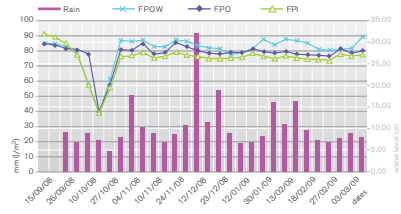
Long term water storage

The field site at the University of Cantabria, Santander, Spain uses 10 full sized tankered car parking bays with different geotextile products and some without a geotextile, with a research aim of comparing the ability of Aquaflow to store the water long term and not lose this precious resource through evaporation.

As can be seen, over several months (August 2008-March 2009) with varying rainfall events, the water stored within the bays is constant and with full or near full capacity (green and blue lines). Even when the stored water was artificially drained from the bays, the input from rainfall soon exceeded the evaporation rate and filled the bays.

Each parking bay contains 1.4m³ (1400 litres) of water that could be used for rainwater harvesting including irrigation. This storage volume is more than enough to obtain all the relevant points

available for the Code for Sustainable Homes Category of Indoor and Outdoor water use. This is due to the volume of stored rainfall provided by Aquaflow to help to reduce mains water in domestic use to a total of less than 80 L/person/day. Typical uses for the water indoors would be toilet flushing and for washing machines. All outdoor irrigation can also be done using Aquaflow rainwater harvesting pavements and all Aquaflow designs are compliant with SUDS for flood prevention, run-off and water quality criteria. This combination of benefits within one solution is space saving, cost effective and has a long and successful track record of delivering large amounts of high quality water to homes and businesses. An amendment to the CSH has recently integrated the importance of water quality into the assessment process, and Aquaflow meets and in many cases exceeds these standards.



Deformation due to traffic

The pavement test facility and test parameters

The pavement test facility (PTF) consisted of a gantry frame spanning a 10m wide, 25m long test pit. The test pit contained the Aquaflow Construction on which a full scale experimental test can be completed. Beneath the gantry frame, a carriage containing a loaded test wheel is mechanically moved backwards and forwards over the pavement construction.

For the purpose of the Formpave testing a wheel speed of 10km/h was selected to simulate the slow speed of lorries in a lorry park. A wheel load of 5.75 tonnes was chosen as this is the maximum permitted load on a wheel (equivalent to an axle load of 11.5 tonnes) and representative of a wheel on the drive axle of a heavy goods vehicle.

The simulated traffic was applied to the pavements in a channelized manner, the loaded dual wheel repeatedly passing over the centre line of the pavement.

Results/Conclusion

The testing was based on 50,000 standard axes with a dry sub-base and 10,000 standard axes with the sub-base fully saturated with water and from the chart below we can see that after 60,000 standard axes the Aquaflow construction deformed only 12mm which is far within the 25mm allowed within the HAUC specification.

TRL Report summary Project report PR/156/01 Formpave PTF trial

This testing was to obtain data following testing at the University of Nottingham, which showed that deformation under heavy traffic may be within acceptable limits.

TRL were commissioned by Formpave to test the Aquaflow System under heavy traffic loading in the TRL's Test Facility(PTF).

The PTF allows full scale pavements to be constructed and tested in a controlled environment under specified loading conditions. The Aquaflow construction was constructed by TRL and measurements were taken throughout to ensure that the sub-base was of appropriate strength.

The pavements were then trafficked with a wheel load equivalent to the maximum permissible for the drive axle of a lorry. Deformation of the surface and trip height between blocks was measured. Failure criteria were based on the Highway Authorities and utilities committee (HAUC) Specification for the Reinforcement of openings in highways.

Standard Contract

Documentation
Workmanship and materials specification clauses. To be read with Preliminaries/General Conditions.

TYPE(S) OF PAVING

110 CONCRETE BLOCK PAVING

Granular sub-base:
As Section Q20

Thickness: To Engineer's specification

Blocks: To BS EN 1338: 2003

Manufacturer: Hanson Formpave

Reference: Royal Forest Range, Chartres or EcoGranite range of paving, setts and cobbles

Thickness: 50, 60, 70, 80 or 100mm

Setting Out: As Architect's Drawing

Bond: To be specified.

LAYING

210 LAYING GENERALLY

Ensure that the sub-base is reasonably accurate and to specified gradients before laying paving.

Cut blocks neatly and accurately without spalling to give neat junctions at edge restraints and changes in bond.

Select blocks from three separate packs in rotation to minimise colour variations.

Lay blocks on a well graded sand bed and vibrate to produce a thoroughly interlocked paving of even overall appearance with regular sand filled joints and accurate to line, level and profile.

220 SAMPLES

Before placing orders submit for approval representative sample(s) of Hanson Formpave products.

ADVERSE WEATHER

Do not use frozen materials or lay sand bedding on frozen or frost covered sub-bases.

Protect stockpiled bedding sand to ensure it does not become saturated.

Protect uncompactd areas of paving from heavy rainfall.

250 ACCEPTANCE OF BASE

Before starting work ensure that the base is sound, clean and suitably close textured.

The levels and falls of the base are as detailed within the specified tolerances of ± 20mm.

260 LEVELS OF PAVING

Permissible deviation from specified levels to be ± 6mm generally.

Paving at drainage outlets to be set 6mm above outlet.

270 REGULARITY

Sudden irregularities are not permitted. Not more than 10mm deviation over three metres, when measured with a three metre straight edge equipped with feet.

280 SAND FOR BEDDING GENERAL

Sand complying with BS 7533 Part 3:1997 Table D.1 and D2.

The sand should be hard, sound and resistant to degradation. Soft sand or calcareous sand should not be used.

Obtain sand from only one source and ensure that all sand supplied has consistent grading.

Maintain at an even moisture content which will give maximum compaction during any laying period.

290 SAND FOR JOINTING GENERAL

Sand complying with BS 7533 Part 3: 1997 Table D.3.

Do not use sand that contains organic impurities or stains the blocks.

300 LAYING BEDDING

Pre-compaction method
Lay, level and compact a layer of bedding material to a thickness of approximately 35mm, then lay and screed to level a further uniformly loose layer. This should have sufficient surcharge to give the required finished levels and an overall bedding thickness of not less than 50mm after completion of the paving.

Post-compaction method
Subject to approval of accuracy and regularity of the finished paving, the bedding may be laid in a single layer thicker after compaction to be not less than 25mm at any point.

Do not leave areas of bedding exposed, proceed with laying immediately after screeding.

Maintain a prepared area of bedding not less than 1 metre and not more than 3 metres in advance of the laying face at all times and not more than 1 metre at the conclusion of any working period.

Do not deliver bedding sand to working area over uncompactd paving. Prevent disturbance to the bedding course by pedestrian or wheeled traffic.

Fill, re-screed and re-compact any parts of the bedding layer which has been disturbed.

310 LAYING PAVERS

Commencing from an edge restraint, lay blocks hand tight, do not use mechanical force to obtain tight joints.

Place blocks squarely with minimum disturbance to bedding sand.

Supply blocks to laying face over newly paving but stack at least 1 metre back from laying face. Do not allow plant to traverse areas of uncompactd paving.

Continually check alignment of blocks by the use of string lines to ensure the maintenance of accurate bond.

Infill with cut blocks as appropriate at edge restraints as work proceeds.

Wherever the type of bond and angle of edging permit, avoid very small infill pieces at edges by breaking bond on the next course in from the edge. Avoid using cut blocks smaller than one third full size.

325 CUT BLOCKS

Cut only sufficient blocks for use in the current operation.

Cut blocks using a block splitter or saw. When using the block splitter set block at a slight angle, to ensure that the exposed face is larger than the underside.

330 VIBRATING PLATE COMPACTOR FOR BLOCK PAVING

Plate Area: 0.35 to 0.50 m²
Force Range: 75 to 100 kN/m²
Frequency range: 75 to 100 Hz

340 COMPACTING AND JOINTING GENERAL

Thoroughly compact blocks with vibrating plate compactor as laying proceeds but after infilling at edges. Apply the same compacting effort over the whole surface.

Do not leave uncompactd areas of paving at the end of working periods, except within 1 metre of unstrained edges.

Check paving after compacting the first few metres, then at frequent intervals to ensure that surface levels are as specified; if they are not, lift blocks and re-lay.

Brush kln dry sand into joints. Re-vibrate surface and repeat as required to completely fill joints.

Avoid damaging kerbs and adjacent work during vibration.

350 REMEDIAL WORKS

During the contract or defects liability period:

Any areas of paving which settle must be re-laid as specified.

Where early traffic leads to migration of the jointing sand re-fill the joints as specified.

High skid resistance paving

All cement and bituminous bound surfaces eventually show a degree of polishing during use. This produces lower slip skid resistance and can be more dangerous in wet weather.

Hanson Formpave have developed High skid resistant blocks and paving manufactured from gritstone with a polished stone value of 70.

Hanson Formpave standard products possess excellent wet skid resistance. There are, however, occasions when enhanced skid resistance surfacing is desirable, for example:

- on steps
- on Access ramps
- on Areas to be used by elderly or infirm people
- on Roads with heavy traffic loading, or in shopping precincts

The polished skid resistance of Hanson Formpave products can be increased by bush hammering the surface, by manufacturing in high PSV gritstone, or by a combination of both.

The table below compares mean skid resistance values obtained on standard, standard bush hammered, gritstone and gritstone bush hammered paving blocks. The results were obtained by independent testing undertaken by Ceram Building Technology a division of Ceram Research Limited.*

* CERAM Queens Road, Penketh, Stoke-on-Trent ST4 7LD.

Product

Product	UPV	PPV	USRV	PSRV
Standard aggregate	76	60	71	57
Standard aggregate, Bush hammered	90	74	88	70
Gritstone aggregate, Bush hammered	92	77	87	73

UPV = Unpolished
PPV = Polished
USRV = Unstrained
PSRV = Polished

The texture depth of Hanson Formpave bush hammered pavers and slabs can be adjusted to active specific depth requirements.

BS technical specification

Paving blocks
Covered by BS EN 1338: 2003

	Standard	Gritstone
Minimum tensile splitting strength (average 3.6 MPa)	2.9 MPa	2.9 MPa
Dimensional tolerances		
Length	+/-2mm	+/-2mm
Width	+/-2mm	+/-2mm
Thickness	+/-3mm	+/-3mm

Small element paving
Comply with BS7243 Part 1:2001

Maintenance and care

All paved surfaces will require occasional cleaning. In normal circumstances, regular sweeping will be sufficient. A range of specialist cleaning products are available; contact your local merchant for details.

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.

Products available to special order

Products made to special order may be on an extended delivery time from receipt of order.

If the quantity ordered is less than 500m² a set-up charge may be levied.

It is essential that sufficient quantity is ordered to complete the contract and this quantity must be taken or paid for in full. If additional product is required a 'set-up' charge may be levied.

Joint filling sand

Hanson Formpave kln dried sand is recommended for use with all types of concrete block paving. Please contact the sales office for details.

Advisory service

Hanson Formpave are pleased to offer detailed technical advice on all products.

Product development

The designs shown in this brochure are illustrative only. Every effort is made to ensure the accuracy of all textual and pictorial content in this brochure.

Hanson Formpave reserves the right to change specifications without prior notice. All Hanson Formpave paving products are backed by BS EN ISO 9001 certification for product quality and service.

