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Hanson Plc a Global Business

Hanson is one of the world's largest suppliers of heavy building materials to the construction industry. We produce aggregates (crushed rock, sand and gravel), ready-mixed and precast concrete, asphalt and cement-related materials and a range of building products including concrete pipes, concrete pavers, tiles and clay bricks.

We are part of the Heidelberg Cement Group, which employs 70,000 people across five continents, has leading positions in concrete and heavy building products and is the global leader in aggregates.

Hanson Building Products is the UK's largest brick and aircrete block producer. We also produce aggregate blocks, bagged aggregate and cement products, renders, pavers, pre cast floors and stairs, SUD systems and prefabricated building systems. The division incorporates London Brick, Thermalite, Red Bank, Cradley, Formpave and Struchterm.



Formpave product directory

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inside back cover



FM 12515



Formpave design and manufacture three sustainable urban drainage systems; Aquaflow permeable paving (BBA certified), Aquaflow water harvesting, Aquaflow ThermaPave together with a wide range of standard and specialist concrete block pavers, kerb systems and ancillaries.

With works situated at Coleford, Gloucestershire and Whittlesey, Cambridgeshire the Formpave plants are some of the most sophisticated of their type in the United Kingdom.

The technology used and the company's quality assurance scheme provides complete works traceability of each product. The Coleford Works has BS EN ISO 9001: 2000 Quality Assurance accreditation and BS EN ISO 14001 Environmental Management accreditation. Formpave is a BSI registered company.

Formpave are flexible and are always pleased to work with specifiers to produce bespoke products, colours and surface textures for special projects.

Established in 1989, and acquired by Hanson Building Products Limited in July 2006, Formpave is the market leader in the manufacture and supply of permeable paving systems, with around 65% of the UK market share.

In addition, Formpave manufacture a wide range of standard and specialist concrete block pavers, kerb systems, and ancillaries.

Additionally, Hanson is a founding member of the UK Green Building Council and is at the forefront of research into whole system design to ensure its products attain optimal performance when used within buildings, particularly with regard to thermal efficiency and waste reduction.

The above commitment is demonstrated through the construction of a Hanson EcoHouse™ at the Building Research Establishment BRE offsite 2005 exhibition at Watford, and a further house for BRE offsite 2007.

The latest house is one of the first houses built to the new Code for Sustainable Housing; achieving a level 4 standard, well beyond current best practice.

Heidelberg Cement has a clear commitment to communicating proactively its sustainability objectives, actions and performance. Heidelberg Cement has produced a long term vision for the next decade, spelling out its main guidelines and targets. The ambitions for 2020 are to:

- Give the highest priority to occupational health and safety
- Deliver a positive contribution to biodiversity
- Act for sustainable construction
- Use waste as a resource
- Protect our climate
- Reduce our future environmental impacts

Aquaflow reinforced sub-base is covered by patent EP 1 373 640

The Geothermal heat pump sump sub-base is covered by p/a EP 057 49 142.5



FM 12515

Aquaflow[®] legislation and guidance

Summary of the legislation that encourages Sustainable Urban Drainage Systems (SUDS) and Permeable Paving Systems (PPS)

Draft legislation published during 2009 seeks to make sustainable drainage systems (SUDS) effectively mandatory by 2011. As the most versatile SUDS technique, with important water attenuation and pollution control characteristics, use of concrete block permeable paving (CBPP) is set to become the norm for new developments.

CBPP is a unique sustainable drainage technology which is being championed by *Interpave*. Its block paving manufacturer members maintain the highest standards of quality control, product innovation and sustainability and are signatories to the British Precast Concrete Federation Sustainability Charter. *Interpave* has the expertise, international contacts and resources to develop technologies such as permeable paving to the benefit of the building industry as a whole. *Interpave* works closely with other organisations such as Defra, Environment Agency, the Scottish Environmental Protection Agency, CIRIA and SUDSnet in driving forward sustainable drainage solutions. Its manufacturing members continue to develop innovative concrete block permeable paving products and systems.

Planning Policy Statement PPS 25 (Communities and Local Government, 2006) sets out Government policy in England on development and flood risk. In Scotland planning policy *SPP7* (Scottish Executive 2004) provides similar guidance, as does *TAN15* in Wales (Welsh Assembly Government 2004). The main aim is to ensure that flood risk is taken into account at all stages of the planning process to avoid placing developments in areas of flood risk or exacerbating flood risk elsewhere as a result of development. PPS 25 identifies that SUDS can deliver improved surface water management and requires that planning authorities should promote SUDS at every level to attenuate run-off and improve water quality and amenity. It states that both the **rates and volumes** of run-off from new developments should be *'No greater than the rates prior to the proposed development, unless specific off-site arrangements are made which result in the same net effect'*. It requires local authorities to reduce flood risk via the planning process in a manner that takes climate change into account and also enhances the environment. It recognises that SUDS can be used on any site.

In Scotland Planning Advice Note PAN 61 (Scottish Executive, 2001) gives good practice advice for planners and developers regarding the use of SUDS in developments.

The *'SUDS Manual'* (CIRIA, 2007) provides best practice guidance on all aspects of the design, construction, operation and maintenance of SUDS.

In particular it places emphasis on the use of source control techniques and requires SUDS designers to consider pollution removal and amenity aspects as well as a more comprehensive assessment of attenuation than has been required previously (to meet the same requirements as stated in PPS 25). Concrete block permeable pavements are ideal to help meet these new design criteria.

Of major importance is the *Draft Flood and Water Management Bill* which, if it takes effect as intended in 2011, will require SUDS on all new developments and roads in England and Wales 'where practicable'. Current arrangements for approval, construction and maintenance of conventional piped drainage will then be replaced with similar procedures for SUDS. A new role for local (unitary and county) authorities as 'SUDS Approving Bodies' will be established and they will be required to adopt all SUDS schemes except single properties. National Standards for construction and maintenance of SUDS systems will also be developed by 2011.

In Scotland, a steering group - formed from the Sustainable Urban Drainage Scottish Working Party and The Society of Chief Officers for Transportation in Scotland (the umbrella body representing all local authorities in Scotland) - has instigated comprehensive guidance on SUDS for adoption. A draft version of *SUDS for Roads* was launched in September 2009.

The design of drainage systems, including attenuation and cleansing of surface water is included in current Building Regulations and Building Standards for England and Wales, and Scotland respectively.

In 2008 the English law changed to promote the use of permeable paving on front driveways. Any retrofit impermeable driveway on a permeable surface such as lawns will require planning permission, be subject to a fee and delay when compared with the use of permeable paving which can be installed freely.

Sustainable urban drainage systems

Aquaflow permeable paving

Aquaflow water harvesting

Aquaflow ThermoPavé system

Research

Design service





Sustainable urban drainage systems **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. With Climate change forecasters predicting as much as a 30% increase in rainfall by 2080 and the problems are increasing year on year.

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.

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. 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.

Formpave's sustainable urban drainage systems allows surface water to infiltrate through the **AquafLOW permeable paving** surface into a unique sub-base before being released in a controlled manner into sewers or water courses. 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.

The water leaving the Formpave system has been cleaned by filtration and microbial action and can be used through the **AquafLOW water harvesting system** for secondary non-potable uses such as flushing toilets and watering soft landscaping; reducing water bills by up to 50%. The patented sub-base can also be designed to accommodate the **AquafLOW ThermoPave system** which combines the technology of the permeable paving and that of heat exchange to heat or cool a building. This can save up to 50% on annual fuel bills and reduce CO₂ emissions by up to 50%.

Legislative drivers for AquafLOW permeable paving
Sustainable drainage systems (SUDS) and permeable paving are recognised as high quality solutions to surface water management. The Hanson Formpave AquafLOW system, as the UK's first and best validated paving system, continues to comply with the requirements for the Code for Sustainable Homes, BREEAM, the EU Water Framework Directive and the DEFRA Future Water document. Water management, pollution removal, rainwater recycling and renewable energy are all addressed by AquafLOW.

The government's future water strategy and permeable paving
Permeable paving is specifically proposed as a solution to drainage problems in the UK in the DEFRA Future water strategy, (Chapter 5, surface water drainage, February 2008). Future flood risk potentially affects 80,000 UK homes and could rise as rainfall intensities and flash flooding increase. The pollution of groundwater and watercourses by contaminated run-off is also noted in Future Water. Permeable paving is specified in Future Water as an economical, robust and appropriate way of managing surface water in a sustainable way, protecting water quality and providing parking space.

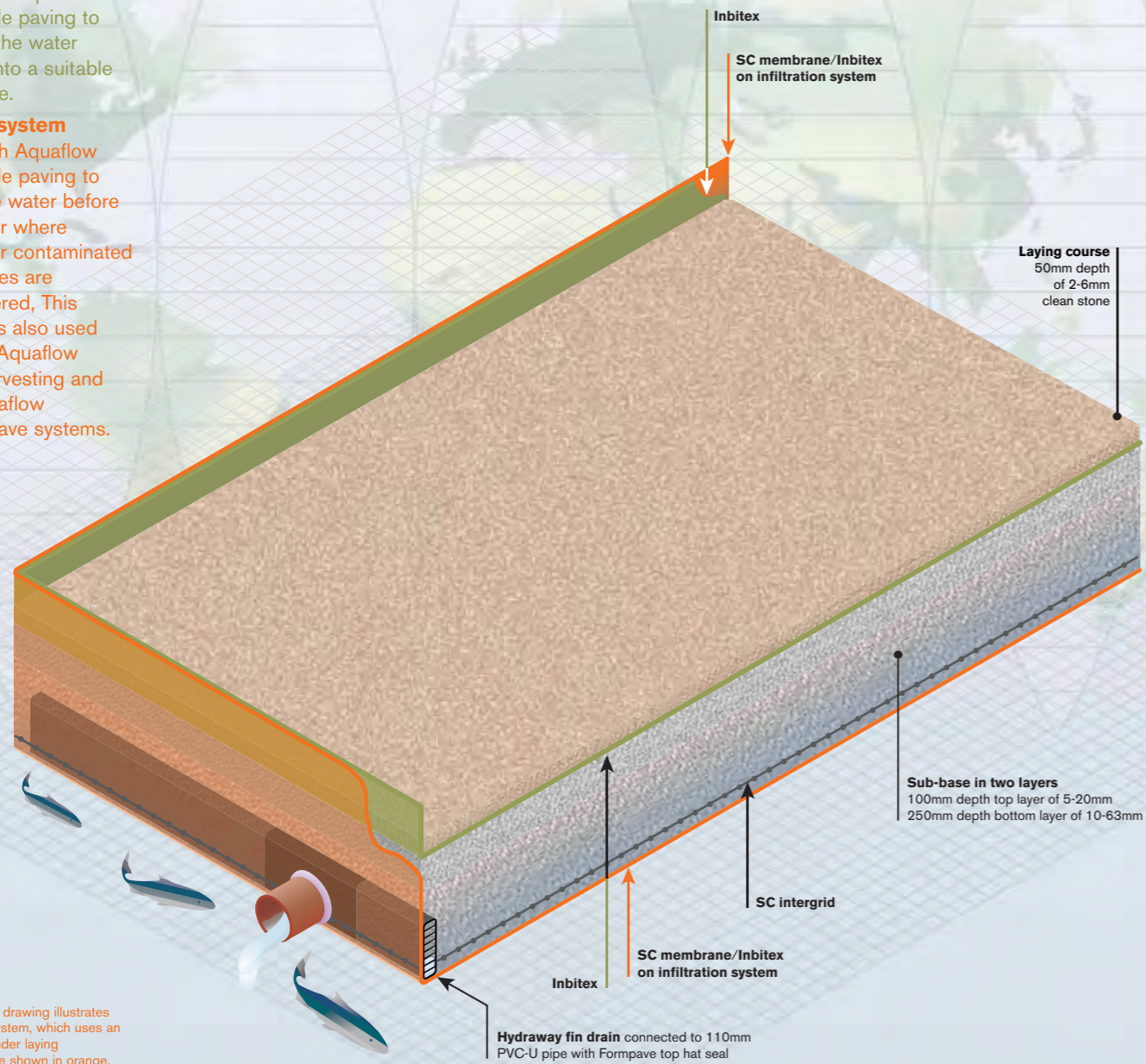
For further information see page 2.

Sustainable urban drainage systems

The patented design can be tailored for tanked or infiltration:

Infiltration system
Used with Aquaflow permeable paving to infiltrate the water directly into a suitable sub-grade.

Tanked system
Used with Aquaflow permeable paving to attenuate water before release or where difficult or contaminated sub-grades are encountered. This method is also used with the Aquaflow water harvesting and with Aquaflow ThermaPave systems.



The isometric drawing illustrates the Tanked system, which uses an impervious underlaying SC membrane shown in orange.

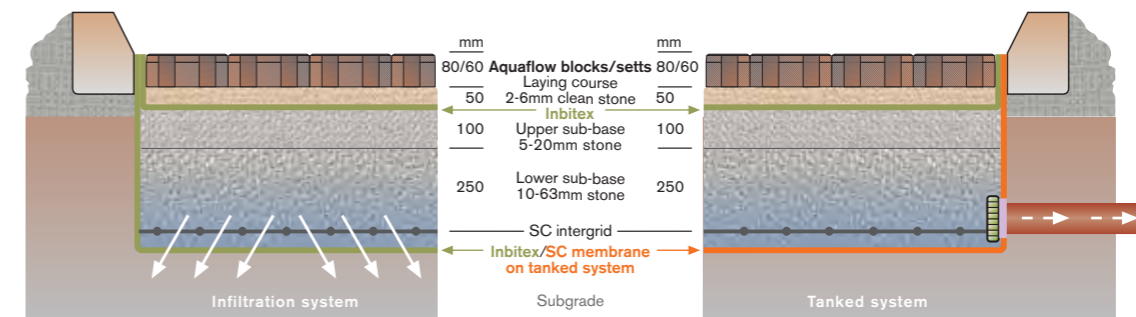
On the Infiltration system the impervious underlaying SC membrane is replaced with a pervious geotextile.

See specifications on pages 59-69

There are 3 typical designs which can be tailored for infiltration or tanked systems and to fulfil the specific requirements of the site.

1 Typical system

Parking areas subject to traffic by cars and vans only for Aquaflow blocks/Aquasett /Aquasett combined



The diagrams illustrate the three designs applied to a typical infiltration system and Tanked system.

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, harvesting 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.

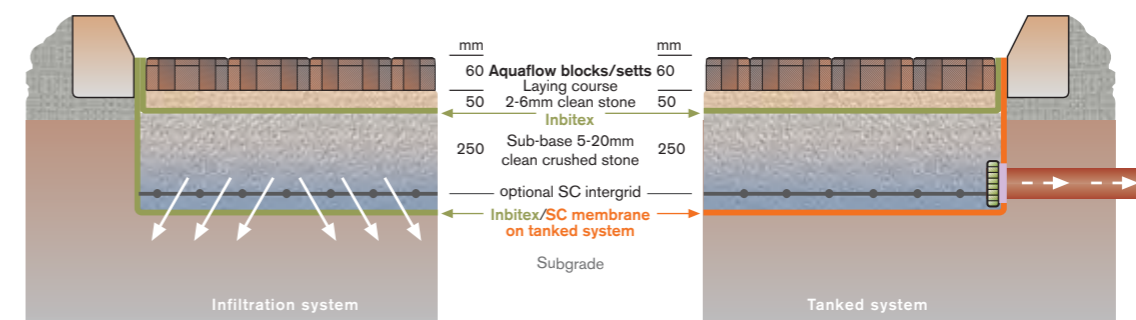
Depth of sub-base can be varied to suit the specific site conditions.

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.

For further information see specifications on page 64-65

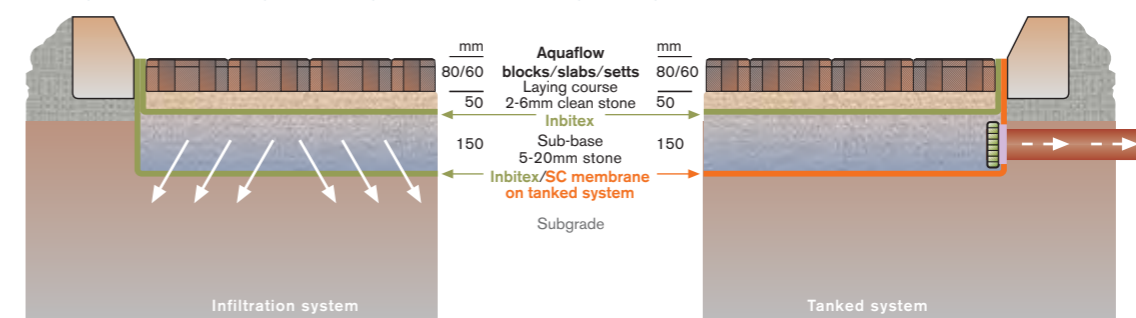
2 Typical driveway system

For Aquaflow blocks/Aquasett /Aquasett combined



3 Typical footpath construction

For Aquaflow blocks/Aquasett /Aquasett combined/Aquaslab paving



The infiltration system has two pervious Inbitex geotextiles shown in green.

On tanked system the underlying pervious geotextile is replaced with an impervious SC membrane shown in orange.

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



photograph copyright of Sustrans

Principal benefits Sustainable urban drainage systems

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 m³.

Type 1 sub-base stone weighs approximately 2.2 tonnes per m³ (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 m² per hour.

Aquaflow hydraulic performance

Extract from an independent study undertaken by H R Wallingford Ltd

For rainfall events with small rainfall depths (5mm and below) there is no effective run-off 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.

The full report is available from our design department upon request.

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 m² 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)

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 man-hole 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.

Medium duty use

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

The medium 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 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.

Heavy duty use

For service yards and full HGV use a DBM layer of 80mm thick punctured at 800mm centres and an additional 100mm of 10-63mm clean crushed stone will be required. This would be subject to specific site conditions.

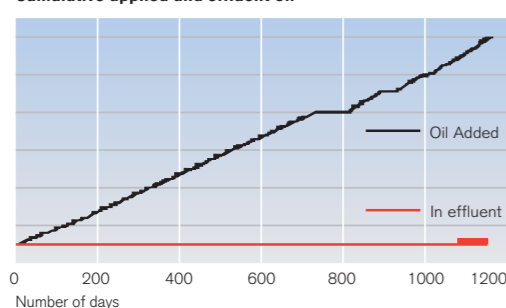
Maintenance and performance

The surface has a design life equivalent to standard block paving. The surface blocks require simple routine maintenance - *see page 65 Maintenance specification.*

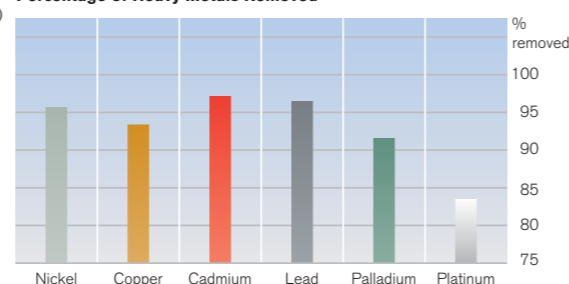
Professor John Argue of the Urban Water Resources Centre at the University of South Australia has undertaken extensive research on the siltation of blocks and laying course. His research assumed rainfall of 580mm per annum with a loading of 200 parts per million of silts. This is similar to the annual 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 m² (900 litres per m²). This would indicate that the surface permeability is still eighteen times what is required to deal with 50mm of rain in an hour.

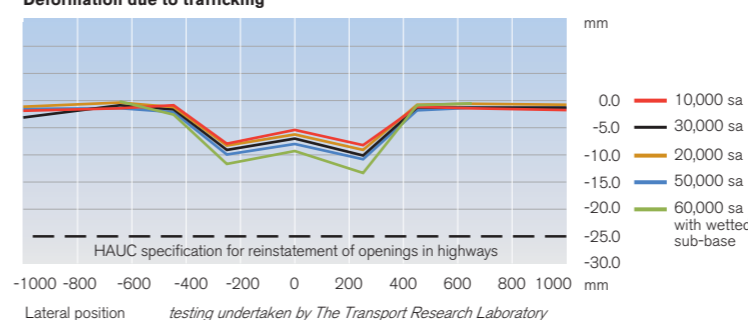
Cumulative applied and effluent oil



Percentage of Heavy Metals Removed



Deformation due to trafficking



Data provided by the kind permission of:
Cumulative applied and effluent oil
Dr Stephen Coupe, University of Coventry.

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

Deformation due to traffic
TRL Report Summary, Project Report PR/PI/106/01, Formpave PTF Trial, see page 69 for further information



Aquaflow permeable paving Used extensively worldwide • Tested over 16 years • Clean and controlled water discharge • Bioremediation of hydrocarbons • Retention of heavy metals • BBA certification • The capacity to deal with rainfall intensities approximately 90 times greater than that required by the regulations.



Formpave introduced the first permeable paving solution to the UK market over 16 years ago and is the market leader with around 65% of the UK market share.

Aquaflow permeable paving system has been successfully installed on over 1,200 schemes within the UK and hundreds more across the world, providing a cost effective and sustainable solution to traditional hard landscaping and urban drainage installation.

Today Formpave continues to lead both the UK and World markets in permeable paving and Sustainable Urban Drainage Systems (SUDS) through ongoing collaboration with leading research institutes, including Coventry and Edinburgh Universities; Transport Research laboratory (TRL); and the University of Cantabria in Spain - a centre of excellence for SUDS in Europe.

Aquaflow permeable paving provides drainage through vertical channels and will allow water through the surface at a rate of approximately 9000mm per hour (9000 litres per m² per hour).

The Inbitex geotextile beneath the laying course will allow approximately 4500 litres per m² per hour through the system and this figure should be used for design purposes.

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

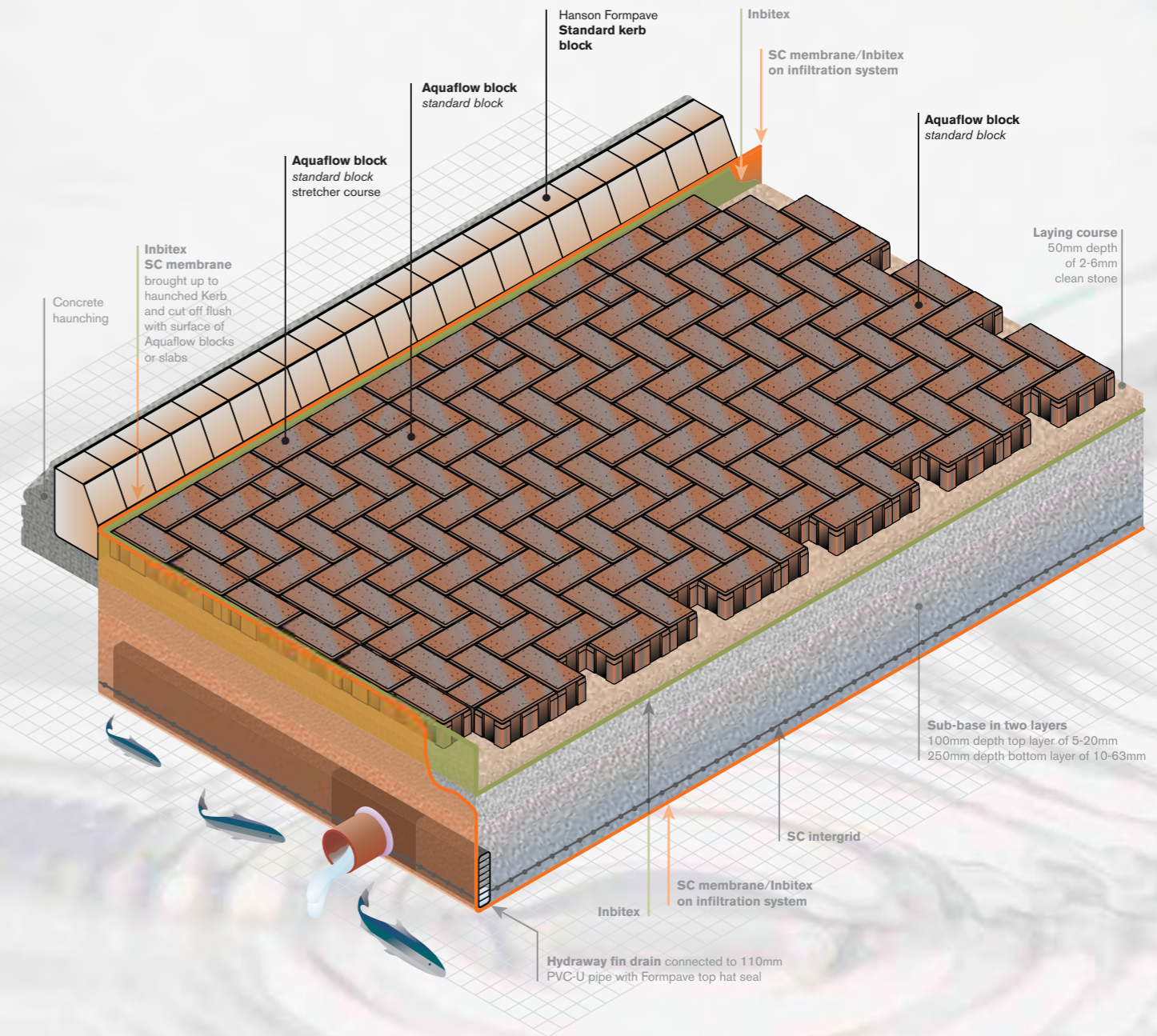
There is a comprehensive range of blocks manufactured with a concrete with a tensile splitting strength in accordance with BS EN 1338:2003.

Both the Aquaflow ML and ML45 blocks can be laid by hand or by machine. Where the blocks are machine laid rates of over 600m² per day have been readily achieved with a three-man crew.

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.

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

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.

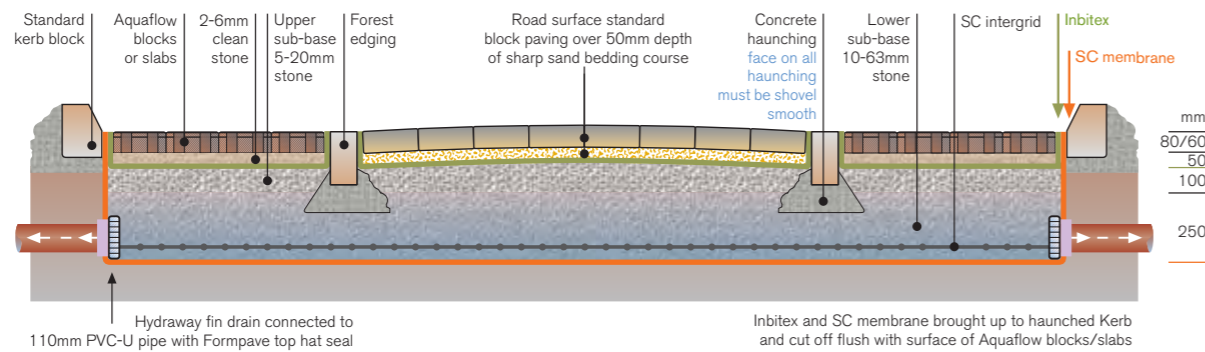


Aquaflow reinforced sub-base is covered by patent EP 1 373 640

See specifications on pages 59-69

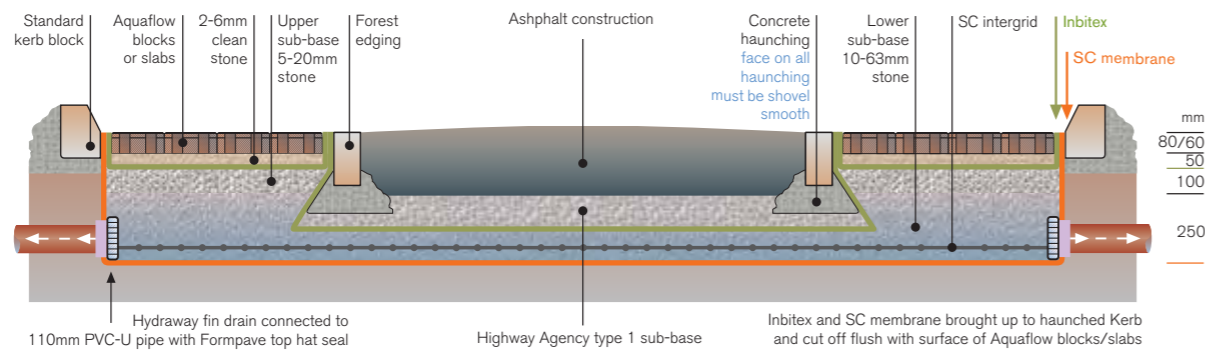
Aquaflow paving in conjunction with standard block paved road surfaces

Tanked system section Aquaflow pavement with undersealing membrane



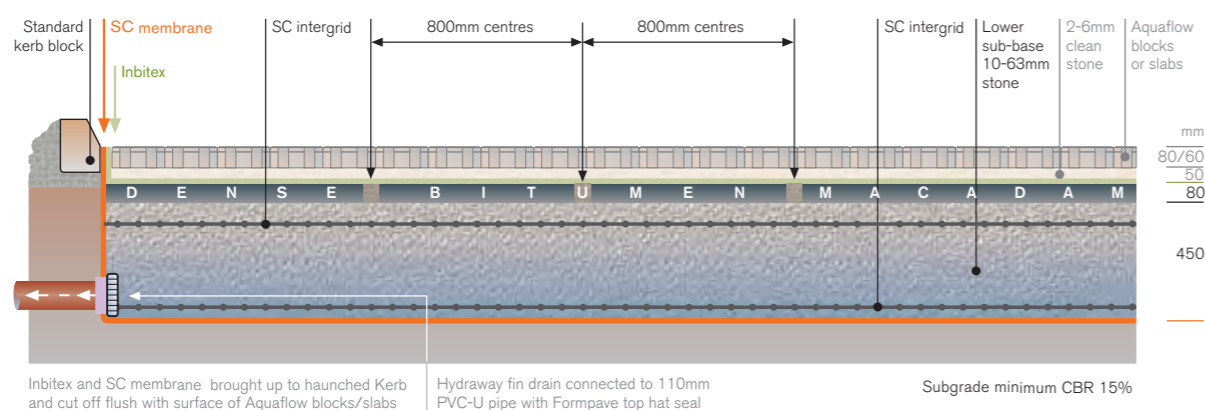
Aquaflow paving in conjunction with asphalt road surfaces

Tanked system section Aquaflow pavement with undersealing membrane



Construction running surface - adoptable design

Tanked system section Aquaflow pavement with undersealing membrane

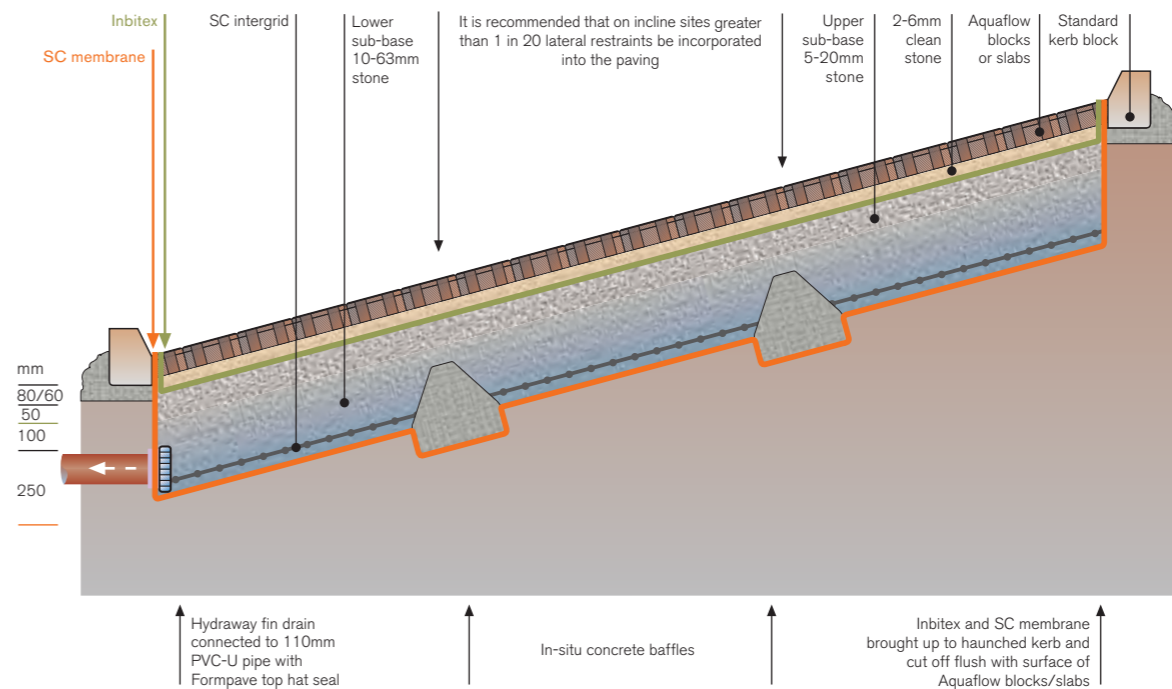


- Lay SC membrane, intergrid, 450mm of sub-base and SC intergrid
 - Lay 80mm of dense base course Dense Bitumen Macadam (DBM) over sub-base (see specification)
 - Fill holes with 2-6mm clean stone
 - Lay Inbitex, 50mm laying course and Aquaflow blocks or slabs
- After building work is completed**
- Clean Dense Bitumen Macadam (DBM) surface
 - Cut 20/50mm diameter holes at 800mm centres through DBM surface into sub-base

The illustrations on this page feature the tanked system for infiltration replace SC membrane with Inbitex

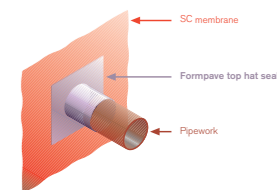
Sloping sites tanked system

Aquaflow pavement with undersealing membrane



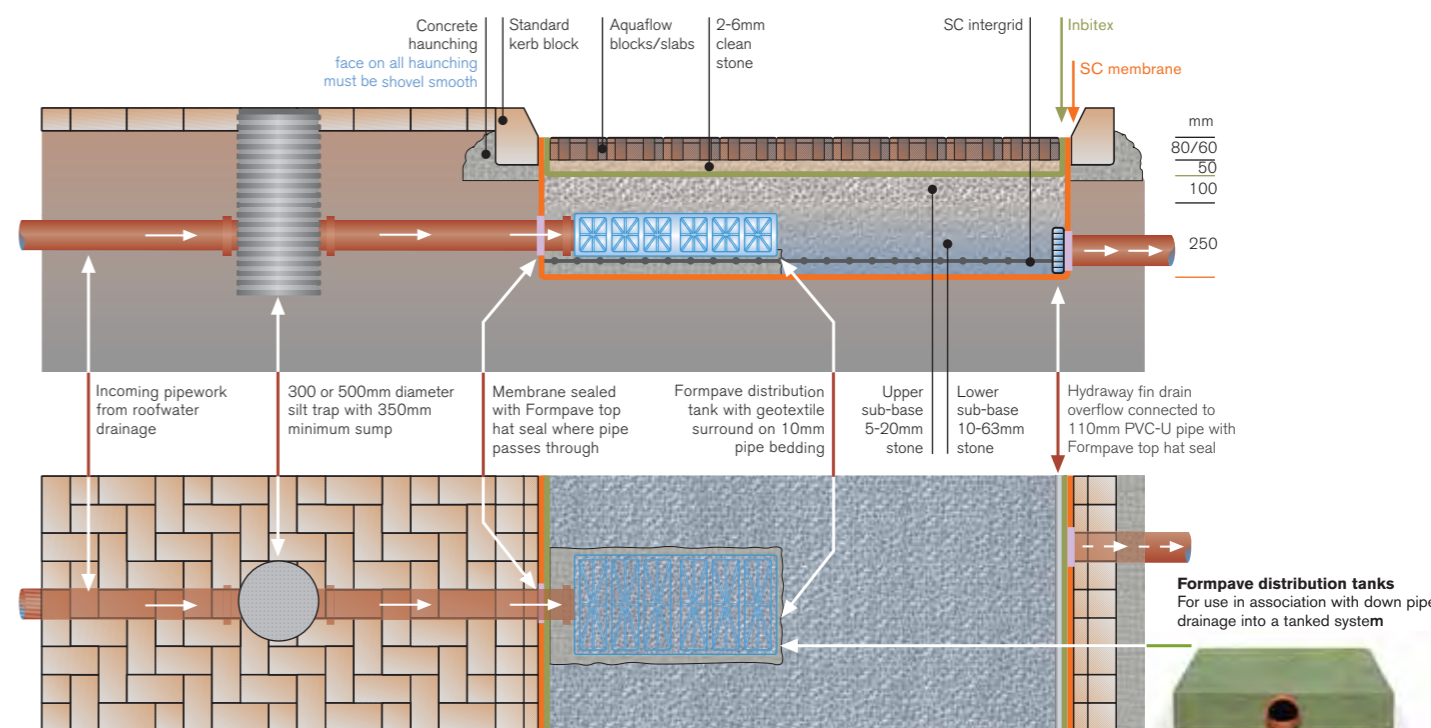
Hanson Formpave design team:
01594 836999 or
designservices@formpave.co.uk

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.



Down pipe drainage into tanked system

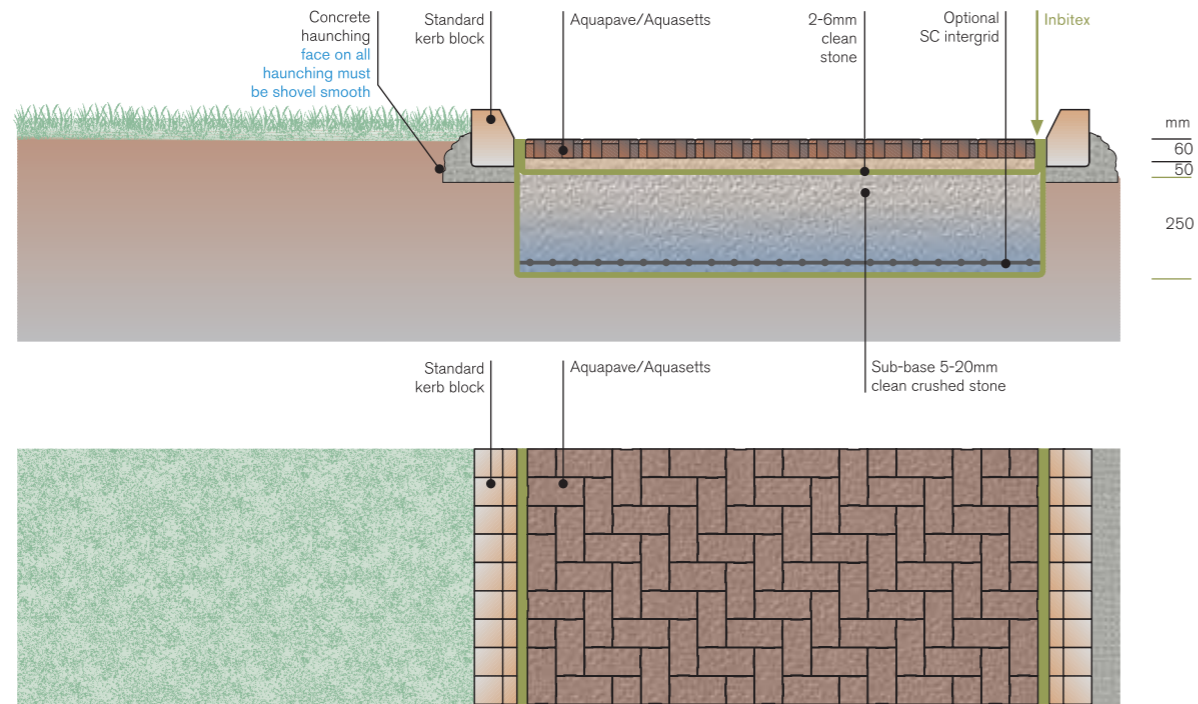
Aquaflow pavement with undersealing membrane



The illustrations on this page feature the tanked system for infiltration replace SC membrane with Inbitex

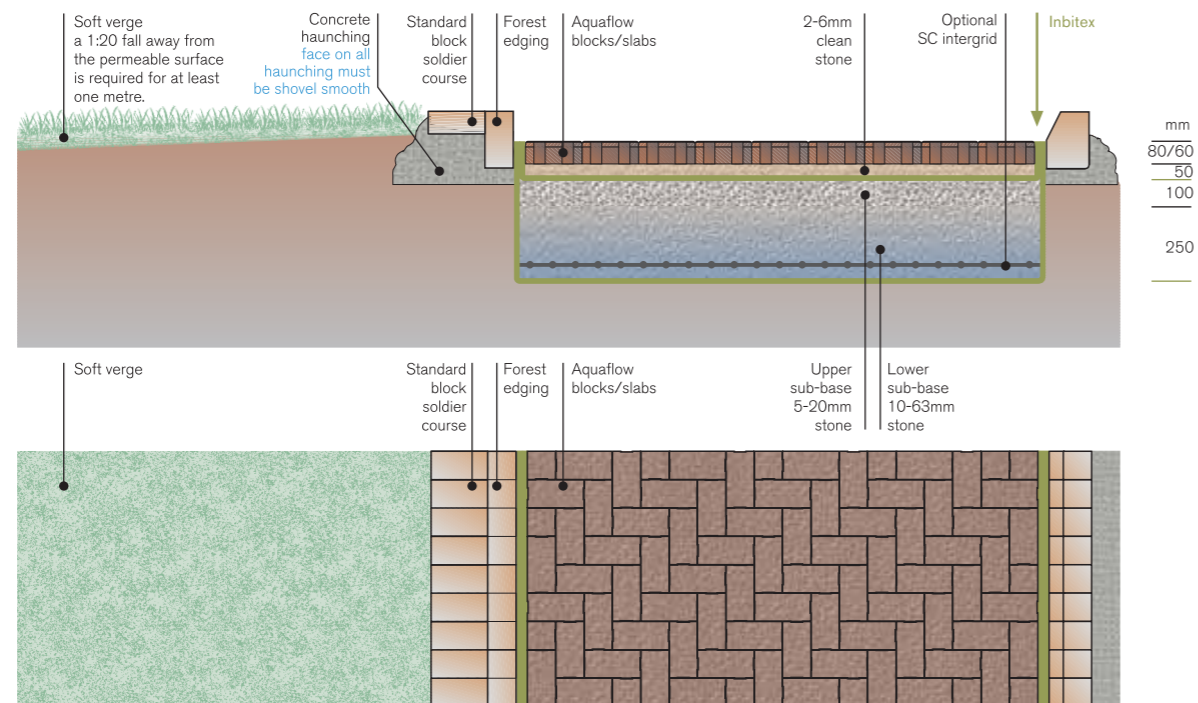
Domestic driveway in Aquapave or Aquasett combined 60mm

Typical detail shown with infiltration system



Soft landscaping and Aquaflow paving

Recommended edge detail shown with infiltration system

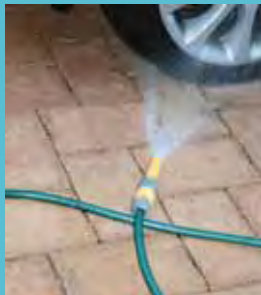


On a tanked system lower *underlying* pervious Inbitex geotextile is replaced with an impervious SC membrane



Aquaflow water harvesting The Aquaflow water harvesting system collects water from all impermeable surfaces, roofs, paths and especially the driveway. All water falling onto the paved surface is cleaned by a geotextile layer (Inbitex) before storage. Recommended uses for this water are garden watering and car washing; these uses can reduce by up to 50% the household requirements for mains water. Because cars are washed on the driveway and the driveway is permeable, even this water is recycled.

Aquaflow water harvesting system with safe and clean water • Beat the Hosepipe ban • Water the garden • Wash the car • Recycle the water



The rainfall (run-off) is stored within this 'reservoir' area with any overflow being discharged into a sump.

The reservoir/sump contains a pump which will allow the harvested water to be dispensed via a tap and hosepipe. Because there is no mains water attachment the harvested water can be used where there are hosepipe restrictions, as the tank is treated as a subterranean water butt.

Car washing becomes an environmentally friendly pursuit as the majority of the water used will automatically be cleaned and recycled as it passes through the permeable paving on the driveway.

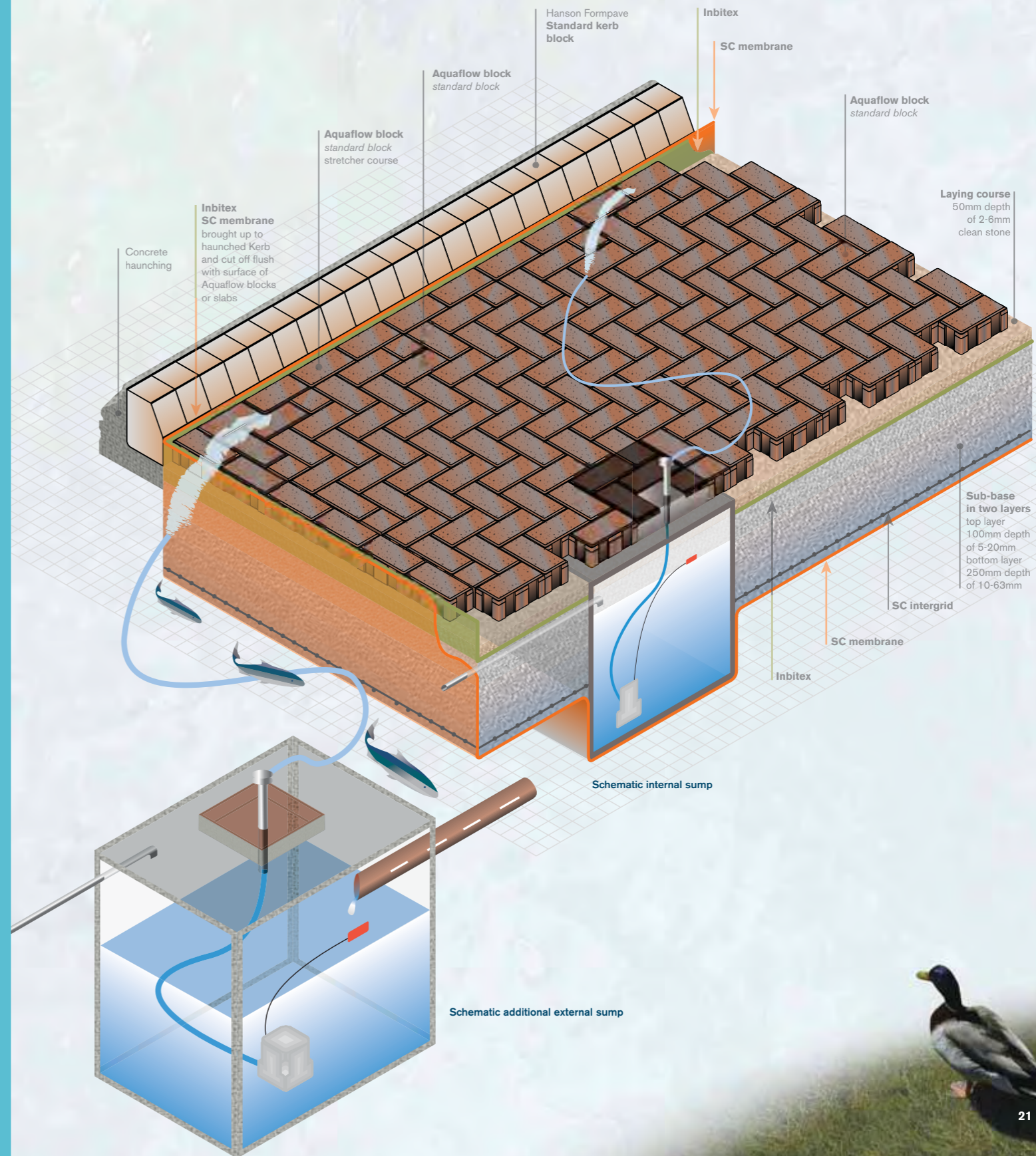
The capacity of the system is dependant on the size of driveway, but additional storage can be achieved by increasing the pump chamber (sump) size. It will be necessary to calculate the approximate quantities of water required set against the estimated quantity of rainfall. This can be done using average rainfall figures.

The water in the Formpave system is cleaned by filtration and microbial action and is suitable for secondary non-potable uses such as flushing toilets and watering.

Water quality has been tested at Edinburgh and Coventry Universities and independently verified by Severn Trent Water Authority. See page 68.

Infiltration is achieved by a thermally-bonded, nonwoven geotextile: Inbitex, specifically developed to optimise the cleansing of water entering the system.

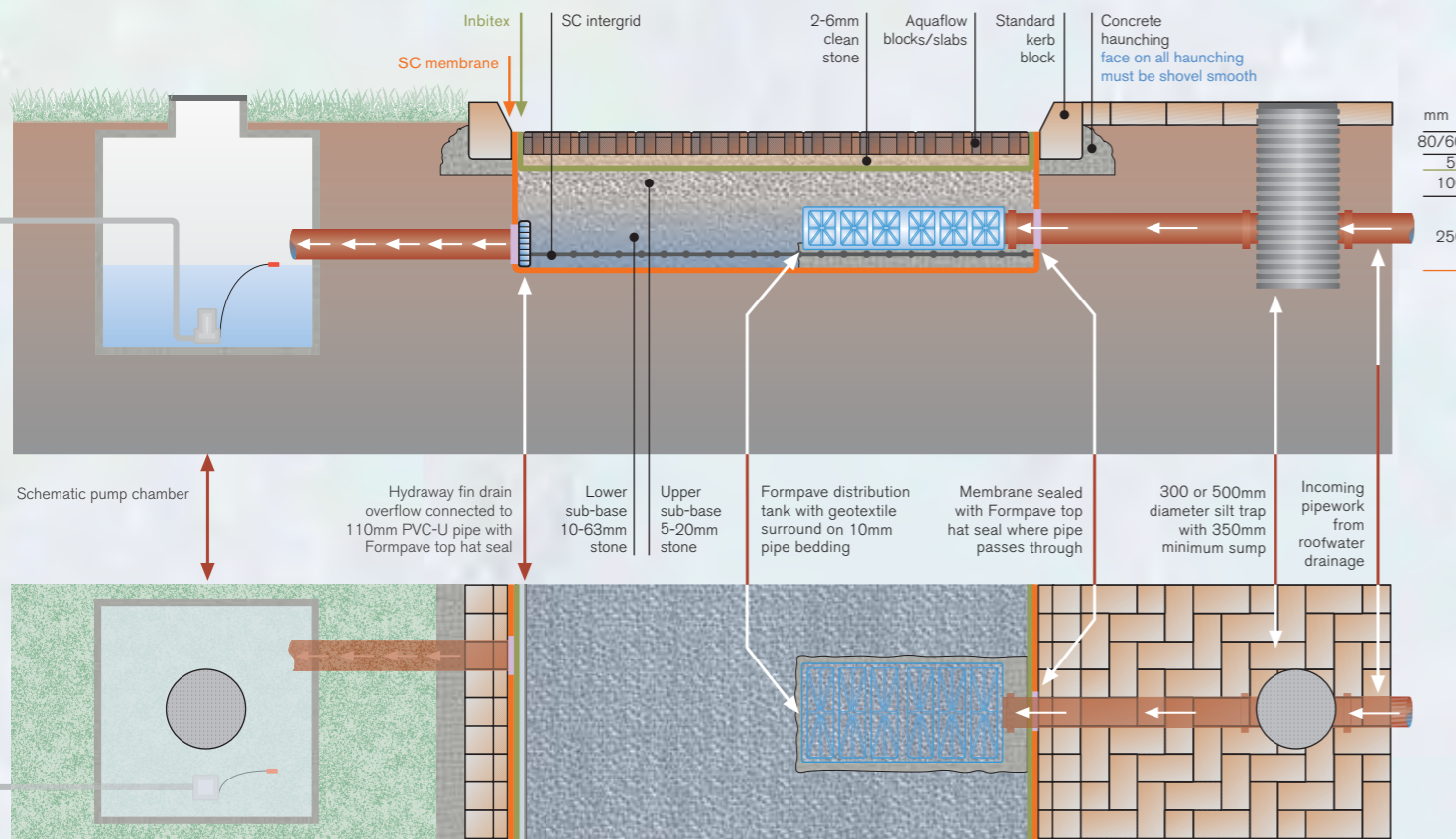
The various characteristics have been combined to create a unique geotextile Inbitex that aids the development of the naturally occurring microbes, and offers them refuge during periods of drought. The system is tanked by an impervious plastic membrane to collect the water.



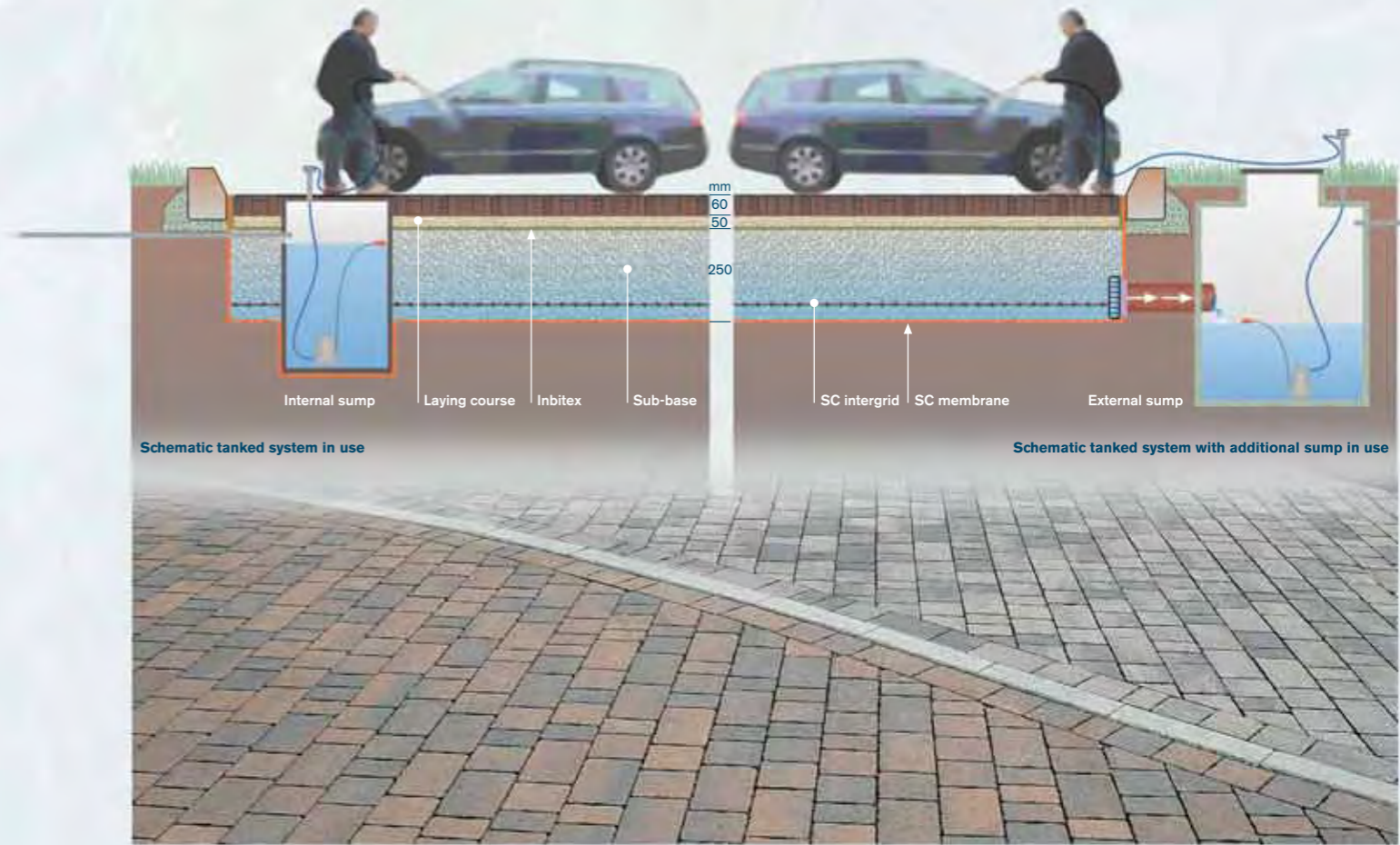
Aquaflow water harvesting

Aquaflow paving in conjunction with water harvesting drainage system

Shown with the Standard Tanked system



- Surface dressing***
2-4mm grit, brushed into the surface of the blocks.
 - Laying course***
2-6mm crushed stone, a 50mm screeded layer.
 - Inbitex**
A green fibre geotextile to filter and clean water.
 - Sub-base***
5-20mm crushed stone, the load bearing layer.
 - SC intergrid**
A square grid that aids the sub base loading capacity.
 - SC membrane**
An impermeable green plastic liner to create the watertight tank.
- *All stone must be clean crushed and angular to allow the sub base to perform to standards.
If additional capacity is required then a sump can be attached to achieve this.



Aquaflow water quality analysis Organics and metals

250 grams of used engine oil per m² of Aquaflow was added to a series of eight model paving systems and simulated rainfall was added four times to wash it through.

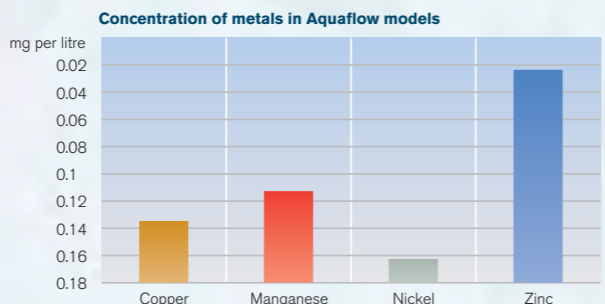
The rate of oil removal was 99.90%. Third party analysis of the effluent was conducted by Severn Trent laboratories (STL) to determine the concentrations of Benzene, Toluene, Ethylbenzene and Xylene; all of these compounds were below the limit of detection for STL, which was 0.1 micrograms per litre.

This shows that these particularly toxic compounds were locked up within Aquaflow and would not be released to receiving systems. Previous research on Aquaflow suggests that this material would be biodegraded by the microbial systems in the aggregates.

Waste engine oil was shown to leach out up to 300 mg/l of zinc when mixed with water. 250g/m² oil was added to a model paving surface, the effluent run-off samples were independently tested for Copper, Manganese, Nickel and Zinc by

Severn Trent Labs. Average results from 20 samples on each element are shown in the accompanying graph. Aquaflow is shown to significantly reduce the metals in discharge, even zinc which had been shown to readily leach out into water before adding to the models.

See page 68 for detailed research on Water quality and Long term storage.



- 1 Excavate to formation level
 - 2 Excavate for pump chamber
 - 3 Line with impermeable membrane and insert pump
 - 4 Spread and compact 5-20mm clean stone
 - 5 Lay Inbitex Geotextile
 - 6 Spread and screed 2-6mm clean stone
 - 7 Lay blocks (handtight)
 - 8 Connect pump and system ready for use
 - 9 Brush in the 2-4mm grit surface dressing
- Maintenance**
Ensure surface is kept clean of soil, brush regularly. May require occasional re-gritting and complete by plate vibrating the area to lock the grit into the joints.

Aquaflow ThermaPave® system The Aquaflow ThermaPave system is capable of reducing a building's reliance on gas and/or electricity for heating and cooling by up to 50%. The patented system for heat capture from stored water can be used to generate 6 kilowatts of energy from approximately 100sq metres of Aquaflow paving for indoor climate control. A heat pump moves the heated or cooled water through either underfloor heating or radiators.

In one hour the sun imparts sufficient solar power to earth to support its total energy needs for one year.
The temperature of the ground from 1 metre to 100 metre depth is around 10°C, anywhere in the world, every day of the year.

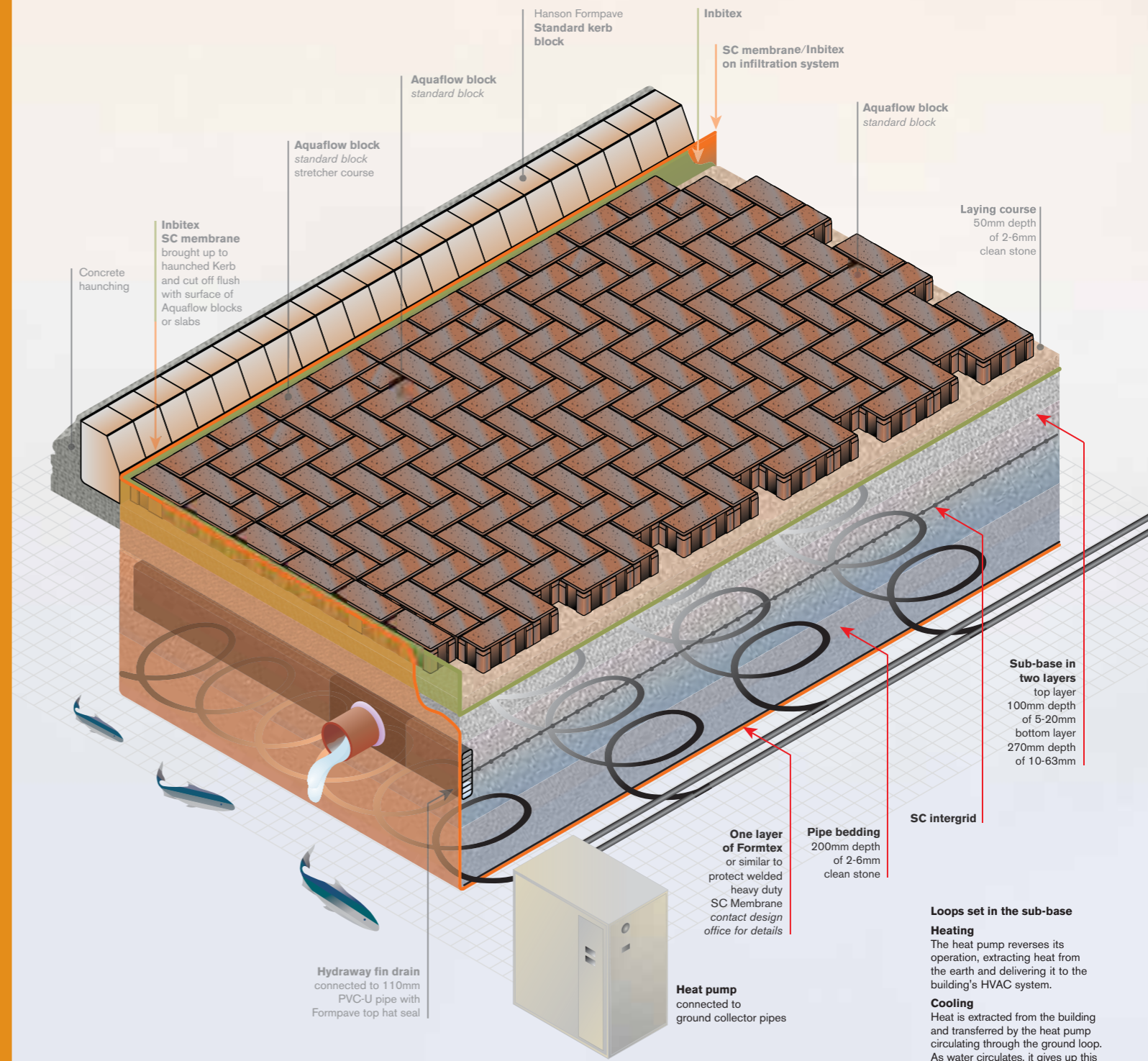
Main benefits of Hanson Formpave's Aquaflow ThermaPave geothermal ground source heat pump system

- Save up to 50% on annual fuel bills - presenting a payback within the first 5-6 years.
- Low Maintenance
- Low noise
- Reduces CO₂ emissions by up to 50%
- Reduces land take
- Cuts water bills by an average of 50% - water stored underground can provide a supply for re-use within the home, i.e. toilets, car washing and irrigation.
- The system can play a great part in mitigating storm flood waters effect on the environment.

The above features add a potential of around 35% of the credits required to conform to Codes for Sustainable Homes level 4.

Hanson-Formpave presents a pavement-based system capable of reducing a building's reliance on gas or electricity for heating and cooling. The Aquaflow Geothermal system combines the technology of the permeable pavement with Geothermal technology by use of a patented sub-base and ground source heat pump (GSHP). A heat pump moves the heated water through either underfloor heating, enlarged radiators or by fan coils. Then by reversing the cycle and introducing chilled water, full cooling is achieved in the property. The typical payback period on a standard system when balanced and operated correctly is around 6 years after which, other than the cost of running the heat pump, heating and cooling costs are completely removed.

When a GSHP is used over a whole year, then for example during summer months warmth can be extracted from buildings and moved during colder times vastly raising its efficiency overall. There is no requirement for the burning of fossil fuels in this system as it uses 'environmentally friendly' and sustainable methods. This can reduce Carbon Dioxide emissions by over 50%, and more importantly can show a reduction of up to 50% on fuel bills. A major benefit is the fact that because the system is installed within a paved area there is no extra land take required only a very small investment in the ground loop thus maximising build potential. The system can play a great part in mitigating storm flood waters effect on the environment.



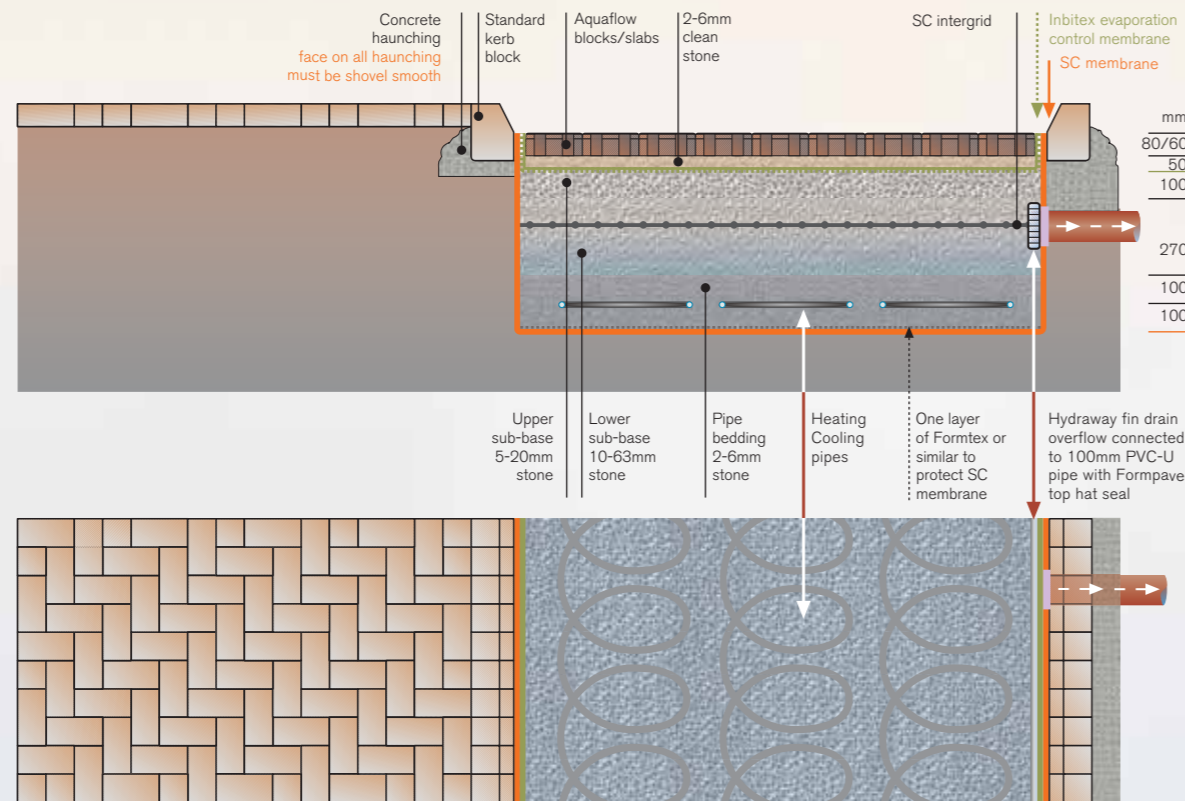
The Geothermal heat pump sump sub-base is covered by p/a EP 057 49 142.5

See specification on pages 59-69

Aquaflow ThermaPave[®] system

Aquaflow paving in conjunction with Geothermal heat transfer

Shown with the Standard Tanked system



The Geothermal heat pump sump sub-base is covered by p/a EP 057 49 142.5

The Aquaflow Geothermal system works by utilising the voided sub-base of the Formpave Aquaflow system to generate sufficient energy to allow the transference (exchange) of heat into buildings during cold periods and out of the building in the summer months. This is achieved by the pump using the constant temperatures of the ground surrounding the installation which are typically used in summer months as heat sinks, and then in the colder times they become sources of heat.

There is an ambient temperature in the sub-grade area of 10 degrees and it is the temperature differential between the loop and the ground that creates the energy produced within the refrigerant that affects the heat exchanger (GSHP). The ground source heat pump acts in a similar manner to a refrigerator, a series of collector loops are set horizontally within the sub-base. It is the refrigerant (water with a brine solution) in the loop that passes the heat to the pump, this then goes through a compressor that channels the heat into the building via under floor heating, radiators or even fan coils.

right Groundwork Trust office building, with 260m² of Aquaflow ThermaPave geothermal system, providing 6kW of under floor heating.

The pump will be powered by electricity but this use of electricity is mitigated by a performance co-efficient in excess of 4:1 i.e. you will get four units of energy for every one you put in. By applying Green tariff electricity the installation offers zero carbon emissions, setting the example for others to follow. Therefore reducing the overall use of non sustainable energy.



1 Fitting welded membrane



2 Lay and compact 2-6mm clean pipe bedding stone



3 Heat weld the horizontal collector pipes



4 Pressurise the system



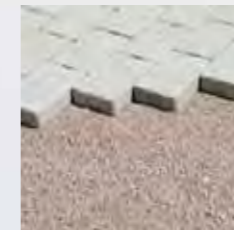
5 Install and compact the graded sub-base stone



6 Compact for laying course



7 Trim Inbitex geotextile to finished paving level



8 Lay the Aquasett permeable pavement



9 Finally brush in the 2-4mm grit surface dressing

Geothermal heat recovery pipes are shown here, being installed by certified personnel. The pipes must be heat welded together and pressure tested and when installation is complete, these pipes have a lifetime guarantee of 50 years. As these pipes represent the only difference in pavement composition from a standard tanked Aquaflow system, the extra cost and alteration to design is minimal. The pipes are simply back-filled after covering with 2-6mm clean stone.

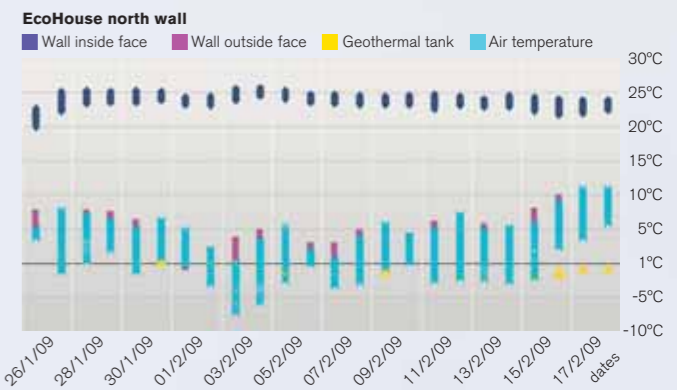


6,500m² of Aquaflow ThermaPave geothermal system supplying 580kW of heating and 200kW of cooling to the 2,700m² office building

Hanson EcoHouse, Case study
The Hanson Formpave Aquaflow Sustainable Urban Drainage System (SUDS) allows heavy rain to infiltrate through a permeable concrete block paved surface into a unique sub-base and collect in a tanked area that combines with a layer of flexible piping connected to a ground source heat pump to provide space heating and domestic hot water.



Aquaflow ThermaPave geothermal system
Ground-breaking research on the use of Aquaflow as a source for ground heat for domestic and commercial buildings has shown the potential for Ground Source Heat Pumps (GSHP) fed by paving water to replace fossil fuels. Shown right is an example of data from the Hanson EcoHouse at Building Research Establishment (BRE) Watford, UK and the performance of ThermaPave in providing a comfortable indoor temperature in 2008 based on only 60m² of paving. The internal wall in the house is subject to indoor temperatures and the GSHP and the external wall is affected by sunlight and the outdoor temperature.



The indoor air temperature is shown in dark blue, with an outdoor air temperature which was below 0°C (shown in light blue). This shows that even in the coldest conditions, the ThermaPave system works effectively.



Research Sustainable urban drainage systems

Hanson Formpave's ongoing program of research and development is helping to establish the next generation of permeable paving systems.

During the past 16 years Formpave have sponsored an ongoing program of research and development into permeable paving systems at a number of academic and independent institutions including Coventry University, Edinburgh University, Abertay University, Delft & Cantabria University, HR Wallingford and TRL at Crowthorne.

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.

Hanson Formpave continue to research new areas within sustainability.

A research project at Edinburgh University is currently monitoring the biological quality of Aquaflow water after storage and its ongoing safety. Areas of long term water storage are sometimes thought to be a potential breeding ground for *Legionella pneumophila* bacteria, the chief causal agent of Legionnaires disease.

In view of this, 20 separate 1 litre water samples were taken from a tanked Aquaflow system that had contained water since 2004. Analysis of the water by Severn Trent labs showed out of a bacterial population of 10,000 cells per millilitre of water, no Legionella bacteria were detectable in 20 litres of Aquaflow water. This demonstrated that the Aquaflow system does not increase the risk of harbouring any of this type of pathogens, even with long term storage.

Another PhD project at the University of Cantabria in Spain is monitoring the long term viability of Aquaflow in storing rainwater where high summer temperatures may deplete the available reserves. Output from the research program is made available via journal publications, conference presentations and promotional material.

Aquaflow and the Code for Sustainable Homes (CSH)

All new homes are required to have CSH rating (since May 2008)

Aquaflow addresses the surface water run-off category and water quality.

Site discharge must be at pre-development run-off rates up to a 100 year return period including climate change, if:

Post development run-off volume is no greater than pre-development including climate change or:

Restricted to Qbar up to an 100 year return period.

Additional credits for the code

2 credits are available for using SUDS to improve water quality

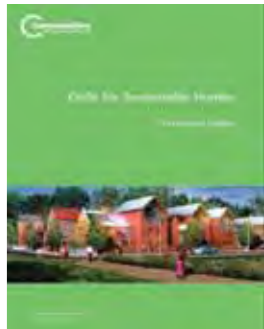
In a real CSH assessment of the Hanson EcoHouse at BRE Watford, (see the picture below) in 2007, Aquaflow provided 4 credits for surface water drainage and flood risk and 5 credits for internal and external water use.

The assessment was done by Arups, and the EcoHouse was the first masonry house to undergo assessment in the UK. The EcoHouse received code 4 status.

Environment impact categories	Credits available category	Points achieved by the Ecohouse
1 Energy and CO ₂	29	18
7 Health and Well-being	12	8
9 Ecology	9	7
8 Management	9	7
2 Water	6	5
3 Materials	24	6
5 Waste	7	7
6 Pollution	4	1
7 Surface water run-off	4	4
Total	104	63

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.

See pages 68-69 for detailed research on Water quality and Long term storage.



The Hanson Ecohouse and the Code for Sustainable Homes
The GSHP at BRE Watford was subjected to the Code for Sustainable Homes assessment process and the paving system was shown to impact on three key categories in CSH; energy, water and surface water, not just water management as many SUDS solutions would. The house CSH rating of code level 4 was achieved with ThermoPave as a key component of a house that greatly exceeded current best practice in sustainability.



Design service Sustainable urban drainage systems. 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 16 years experience in designing permeable paving systems.



Design criteria
The sub-base has a reservoir capacity of approximately 30%. As a quick rule of thumb - 10m² 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.



We take this

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.

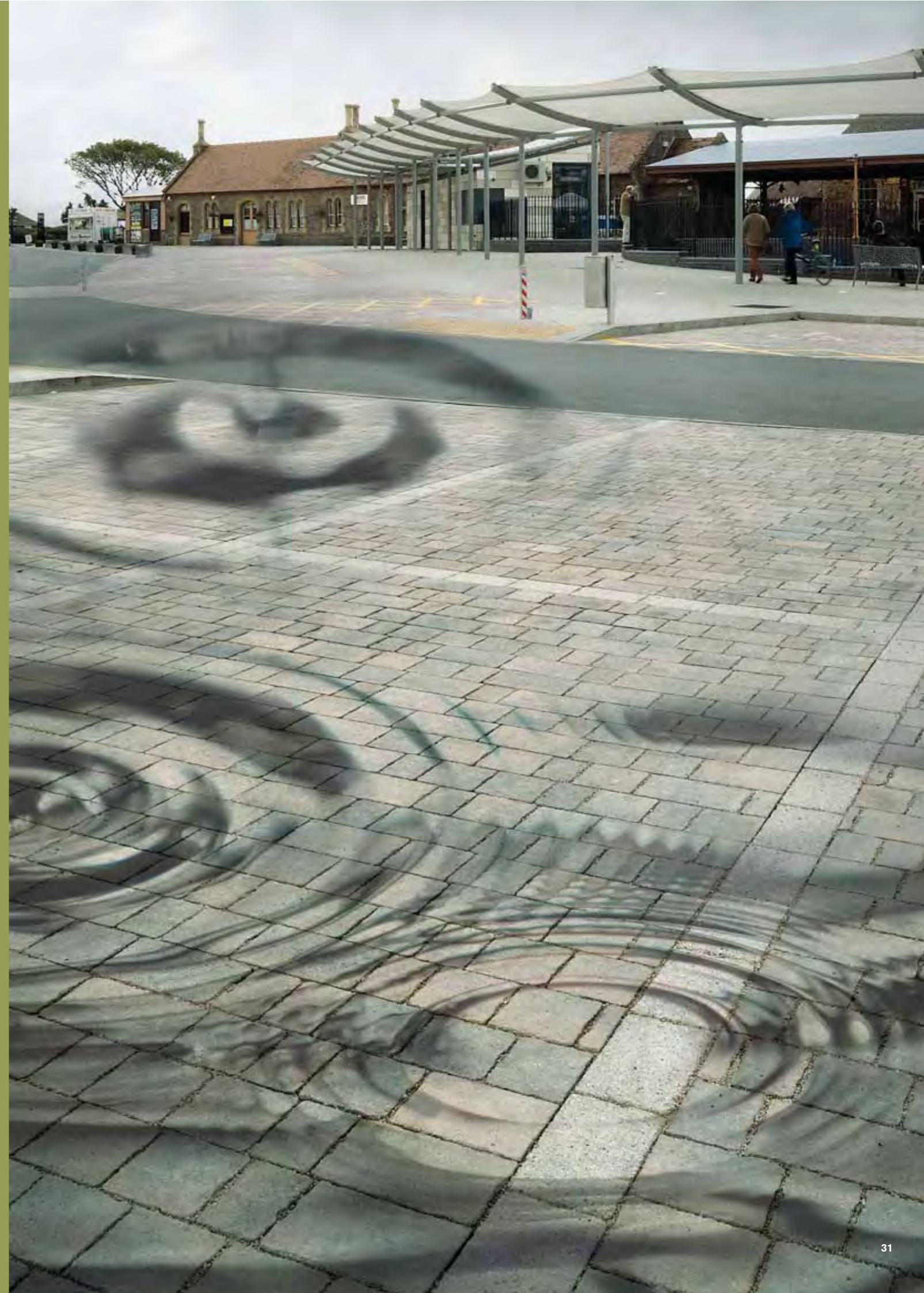
Hanson Formpave have patent protection on both their reinforced sub-base and geothermal heat pump sub-base systems.



We provide this

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 page 63.

Design office 01594 836999
designservices@formpave.co.uk



Standard paving systems

EcoGranite

Chartres range

Royal Forest

Tactile paving

Small element paving

Kerbs systems and edging

Transition kerbs



Chartres setts in Purbeck with an olden finish



EcoGranite sets and cobbles in Cornish Natural

EcoGranite™ cobbles • setts • long setts • paving

The Formpave EcoGranite is 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. The EcoGranite range contains up to 77% recycled materials.

The advantages of the Hanson Formpave EcoGranite over natural granite are price, ease of laying, consistent joint widths and a regular surface that is pedestrian friendly. The bush-hammered surface finish exposes the sparkling granite and gives excellent slip-skid resistance.

EcoGranite is available under two colour ranges: Cornish and Royal Deeside; both consist of cobbles, setts, long-setts and paving.

The Cornish colours are based on the natural granites of Cornwall and include Cornish Natural (a sparkling white granite with black flecks), Tintagel (a light yellow granite) and Truro (a natural and charcoal brindle granite).

The Royal Deeside colours are based on the distinctive appearance of the dazzling granites found in the Royal Deeside region of Scotland. They include Balmoral (a black granite with white flecks), Braemar (a red granite with black and white flecks), Victoria (a white and yellow brindle granite) and Lochnagar (a red and charcoal brindle granite).

EcoGranite is totally flexible and enables the specifier to produce designs tailored to individual needs from traditional formal coursing to a more random formation.

EcoGranite cobbles are produced in a 60 or 80mm thickness in a 100x100mm module. They can be coursed or laid in more unusual patterns such as circles or flanders fans.

EcoGranite setts have the distinctive appearance of natural granite setts used throughout the country. 48 separate paving blocks are used to provide 0.75m² of paving and are delivered in a standard laying pattern, which can be varied.

EcoGranite long setts have been created to replicate the long setts traditionally used in historic Cornish villages and cities such as Truro. They are supplied in a 80mm thickness in a blend of 3 different lengths and are designed to be laid randomly. *Available to special order.*

EcoGranite paving offers an alternative to the often repetitive use of slabs and small element paving. There is a variable coursing width of 225 and 275mm, each layer contains 12 separate paving blocks of 7 various sizes are delivered in a standard laying pattern which can be varied to suit individual designs. Paving is manufactured in a 70 or 80mm thickness as standard. A 100mm thickness is available to special order.

EcoGranite kerb system, edging and starter circles have been specially designed to complement the range and are available in Cornish and Royal Deeside colours with a bush-hammered finish.

Product Summary

Use
Roads and footpaths on commercial, industrial and domestic sites.

Thickness
EcoGranite cobbles 60 and 80mm.
EcoGranite setts 60 and 80mm.
EcoGranite paving 70 and 80mm (100mm are available to special order).
EcoGranite long setts 80mm, available to special order.

Spacing nibs
1.5mm nibs are incorporated within the block dimensions, to standardise joint widths.

Aggregate/skid resistant
The granite aggregate and the bush hammered finish gives excellent slip skid resistance see page 71.

EcoGranite edging
EcoGranite edging is specifically designed to provide a compatible edge restraint.

EcoGranite starter circles
Available to special order.

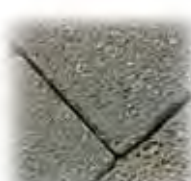
Drawings
Detailed drawings of the Formpave EcoGranite range are shown on page 37

Finishes and colours
Bush hammered finish.
Cornish colours:
Natural, Tintagel, and Truro
Royal Deeside colours:
Balmoral, Braemar, Victoria and Lochnagar.

Joint filling sand
See page 71.

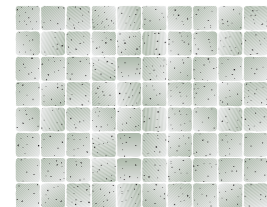
	thickness	
	60mm	80mm
EcoGranite Cobbles		
square metres	11.2	8
number 100x100mm	1120	800
weight tonnes	1.47	1.41
Setts		
square metre	10.5	7.5
number small blocks 100x100mm	126	90
medium blocks 150x100mm	406	290
large blocks 150x150mm	140	100
weight tonnes	1.38	1.31
Long setts*		80mm
square metre	—	7.2
number small blocks 100x250mm	—	70
medium blocks 100x300mm	—	70
large blocks 100x350mm	—	70
weight tonnes	—	1.05
Paving **	70mm	80mm
square metre	9.30	7.75
number *** mixed sizes	144	120
weight tonnes	1.43	1.37

* available to special order
** 100mm paving available to special order
*** see drawings on page 37



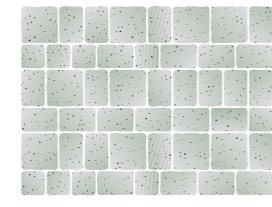
Bush hammered finish

EcoGranite cobble



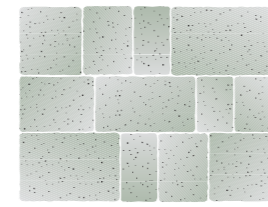
manufactured format

EcoGranite setts



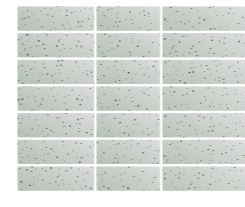
manufactured format

EcoGranite paving



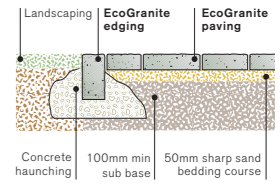
manufactured format

EcoGranite long setts range

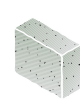


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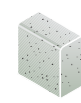
EcoGranite™ cobbles • setts • long setts • paving



EcoGranite edging



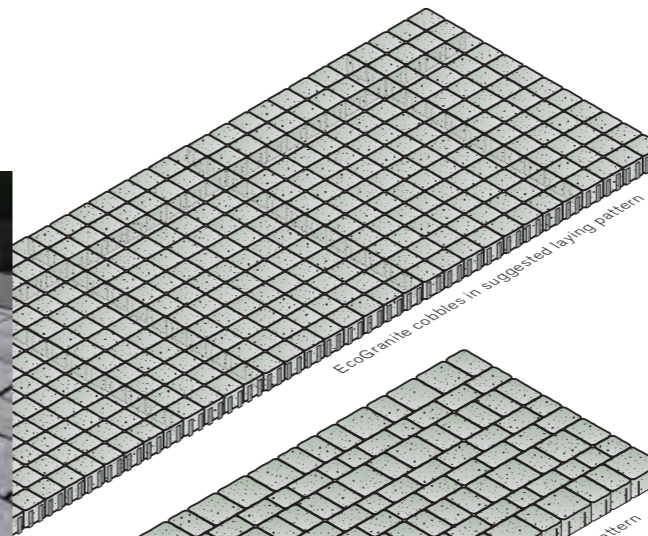
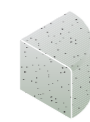
EcoGranite kerb



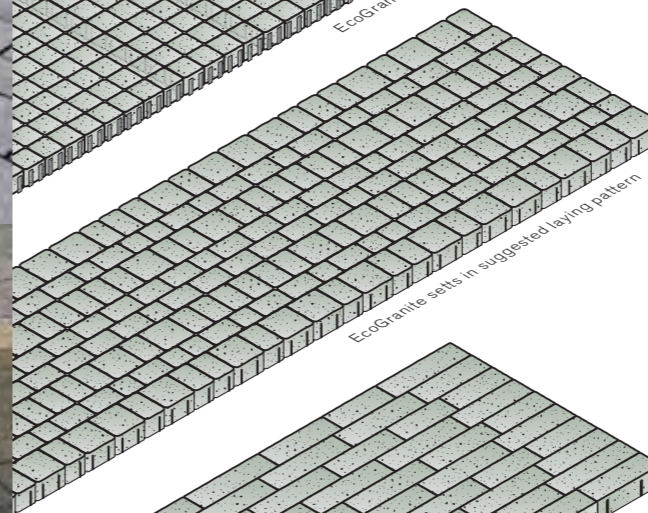
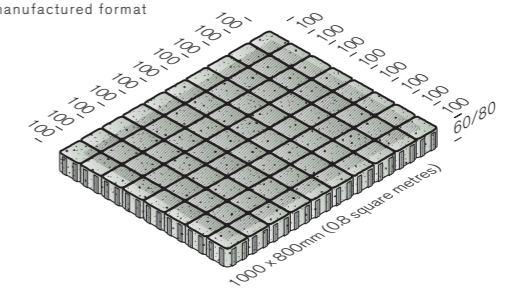
EcoGranite centre stone



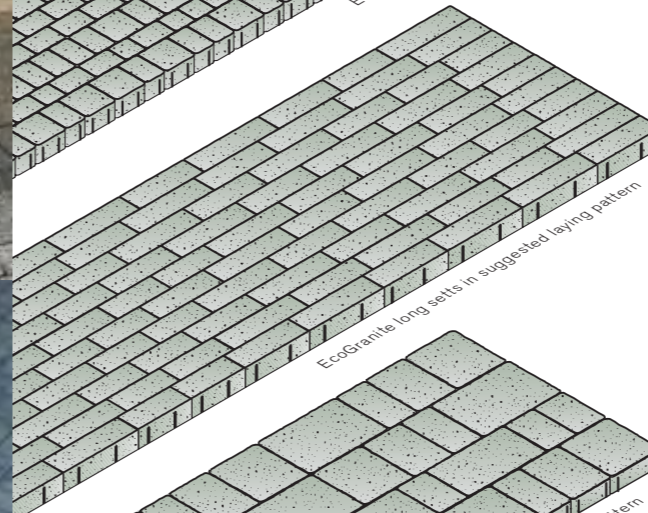
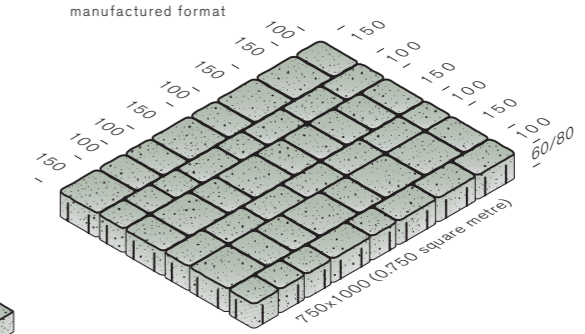
EcoGranite quadrant



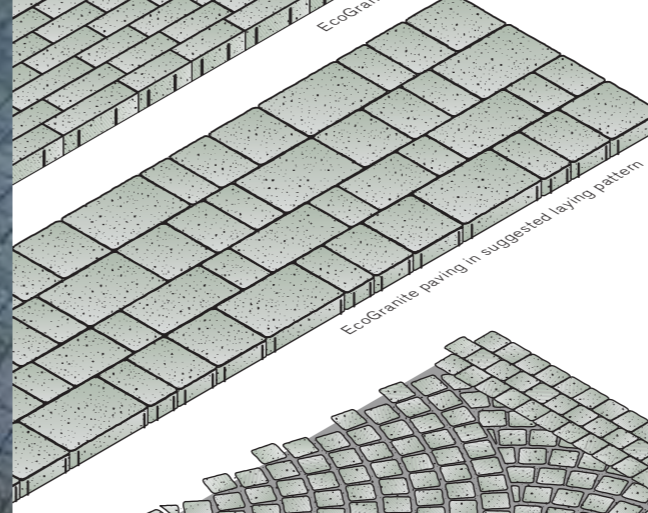
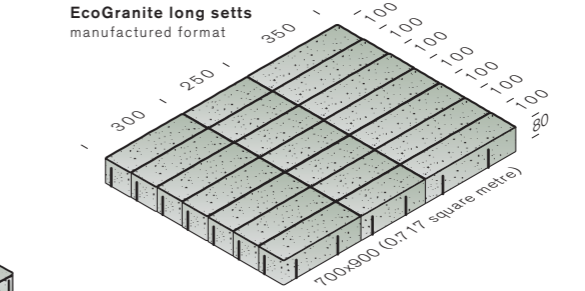
EcoGranite cobble
manufactured format



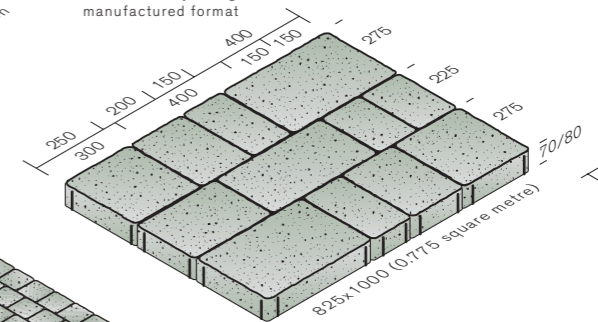
EcoGranite setts
manufactured format



EcoGranite long setts
manufactured format

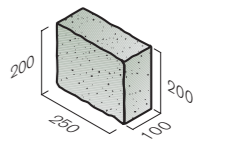


EcoGranite paving
manufactured format

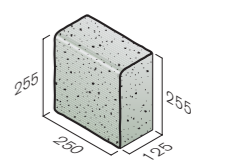


EcoGranite paving 70 or 80mm standard thickness, 100mm available to special order

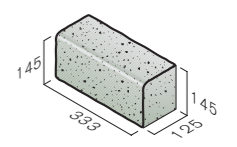
EcoGranite edging



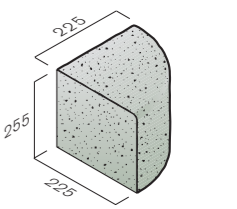
EcoGranite kerb



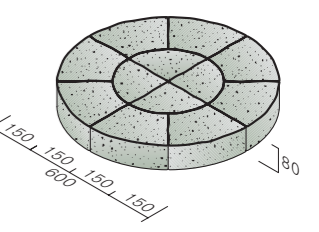
EcoGranite centre stone



EcoGranite quadrant



EcoGranite starter circle



The sides and base of the cobbles, setts, long setts and paving are not distressed, thus maintaining the structural integrity of the paved surface. Spacer nibs are incorporated on each block.



Chartres classic combined in Vendage with an olden finish

Chartres™ range classic modular paving

The concept of Chartres paving was inspired by the beautiful medieval city of Chartres in northern France.

Chartres is manufactured with an olden finish and has been specifically designed for use in conservation areas or on projects where architectural heritage is a major consideration.

Chartres classic Traditional paving faithfully reproduces the mixture of colours and maturity found in the city. It is a blend of 3 colours; golden brown, mid brown and charcoal.

In addition to the Traditional colour, Chartres classic is also available in Vendage, Pennant, Purbeck and Cotswold.

Chartres edging and Chartres starter circles have been specially designed to complement the Chartres range and are available in the same colours with an olden finish. Standard and Bull nose kerbs are available with complementary textured finish to special order.

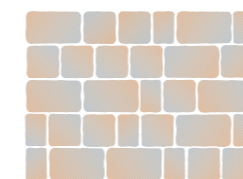
Chartres classic combined modular paving

Comprises of 3 module sizes, each layer is mixed enabling the specifier to create a variety of laying patterns from strict coursing in one or more sizes to a totally random pattern.

Chartres classic large modular paving

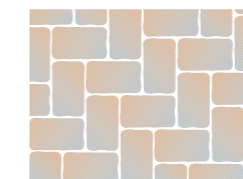
Chartres large is a single module 250 x 150 with a 60mm thickness and is available in separate packs for use as an edging detail. It can also be laid in a herringbone format; this is the recommended pattern for trafficked areas. Available in Charcoal and Traditional, other colours are available on request. For heavier loadings 80mm thickness is available to special order.

Chartres combined



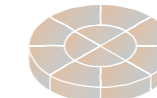
large, medium and small combined

Chartres large



large only

Chartres starter circle



Chartres edging



	per pack thickness		
	50mm	60mm	80mm
Chartres combined			
square metres	11.2	11.2	8
number			
small blocks 100x150mm	98	98	70
medium blocks 150x150mm	196	196	140
large blocks 250x150mm	140	140	100
weight tonnes	1.23	1.47	1.42
Chartres large 250x150mm			
square metres	-	60mm	-
number	-	280	-
weight tonnes	-	1.38	-

Product Summary

Use
Roads and footpaths on commercial, industrial and domestic sites.

Thickness and modules
Chartres combined: 50, 60 and 80mm thick in module sizes: 150 x 100mm, 150 x 150mm and 250 x 150mm.

Chartres large: 60mm thick in module size 250 x 150mm.

Spacing nibs
The 1.5mm spacer nibs are incorporated within the block dimensions.

Chartres edging
Chartres edging is specifically designed to provide a compatible edge restraint.

Chartres starter circle
A compatible starter circle is available in all Chartres colours.

Aggregate/skid resistant
The blocks are available in normal aggregate or high skid resistant gritstone to special order see page 71.

Drawings
Detailed drawings of the complete range of Chartres products together with traditional laying patterns are illustrated on page 40.

Finishes and colours
Olden finish in five colours; Traditional, Vendage, Pennant, Purbeck and Cotswold. Chartres large is only available in Traditional and Charcoal.

Special colours and a bush hammered finish are available to order.

Joint filling sand
See page 71.



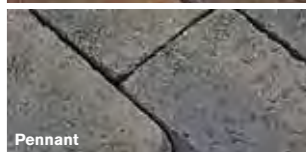
Charcoal grey Chartres large only



Traditional



Vendage



Pennant



Purbeck



Cotswold



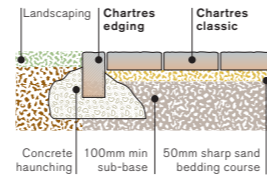
Olden finish



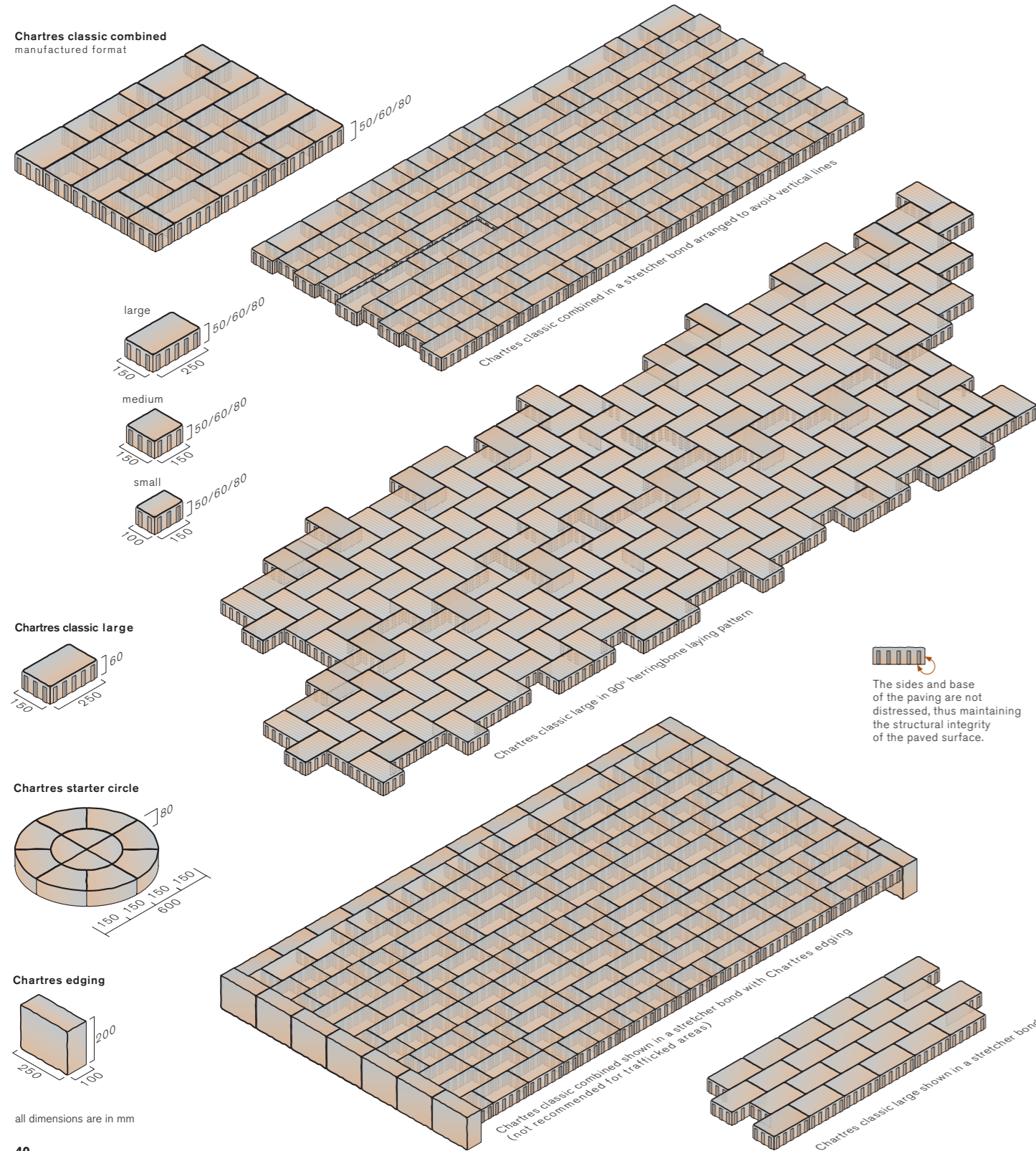
Bush hammered finish
Special order

See inside back cover for further information on colours and finishes

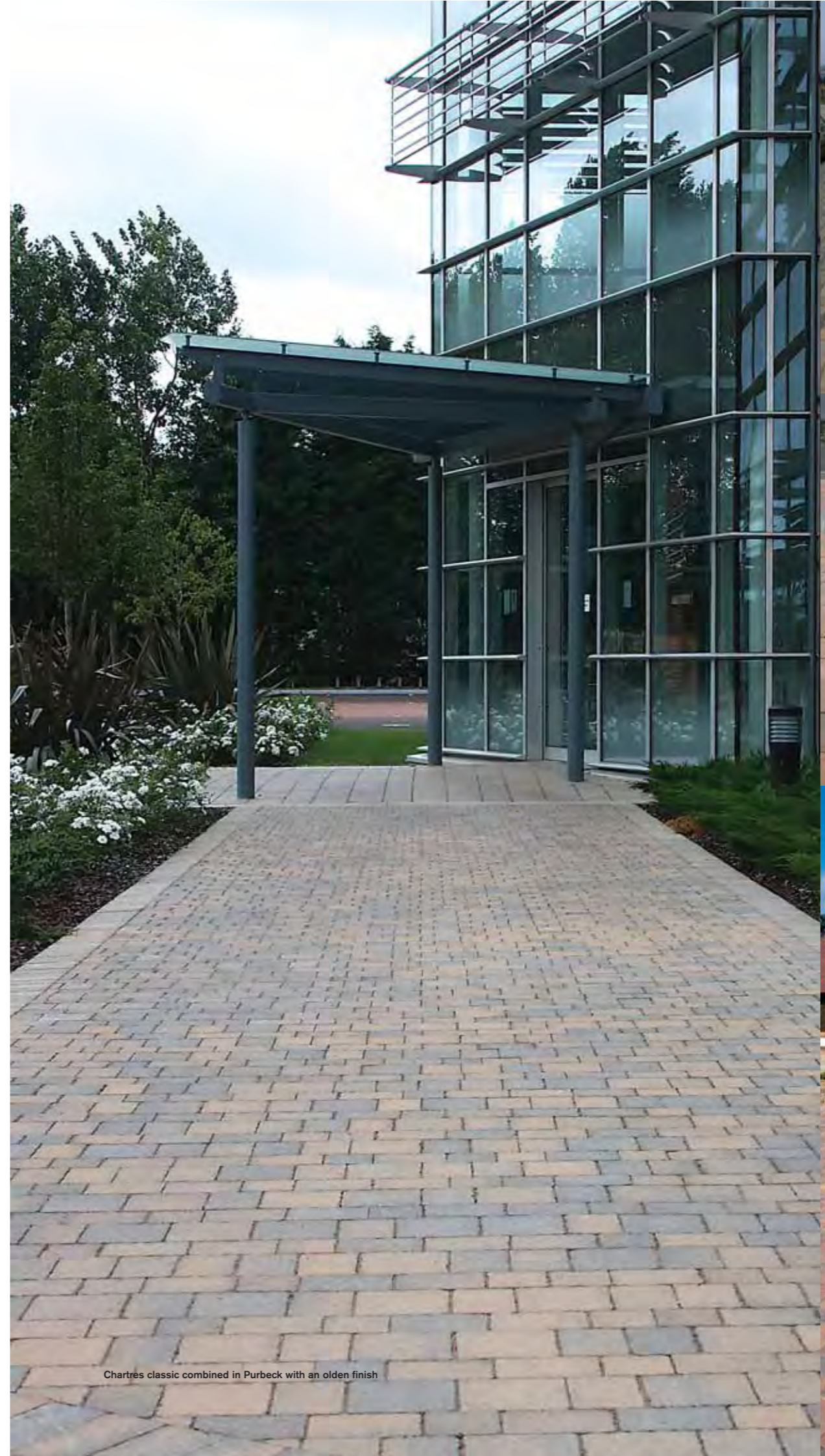
Chartres™ range classic modular paving



Chartres classic combined
manufactured format



all dimensions are in mm



Chartres classic combined in Purbeck with an olden finish



Chartres classic combined in Purbeck with an olden finish



Chartres classic combined in Traditional with an olden finish



Chartres classic combined in Vendage with an olden finish



Chartres setts in Purbeck with an olden finish

Chartres™ range cobbles • setts • boulevard paving

The Chartres range also consists of cobbles, setts and boulevard paving. The colours and olden finish make the range particularly suitable for use in conservation areas or on projects where architectural heritage is important.

The Chartres Range is totally flexible and enables the specifier to produce designs tailored to individual needs, from the traditional formal coursing to a more random formation with no regular jointing.

Chartres cobbles are 60 or 80mm thick and are manufactured in a 100 x 100mm module. They can be traditionally coursed or laid in more unusual patterns such as circles or flanders fans.

Chartres setts have the distinctive appearance of natural stone setts traditionally used throughout the country.

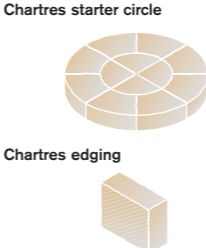
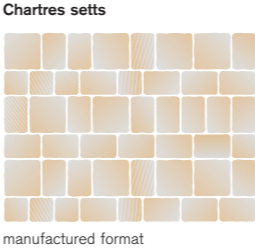
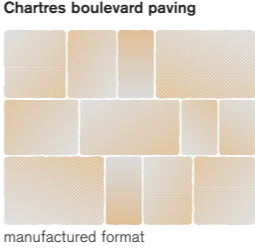
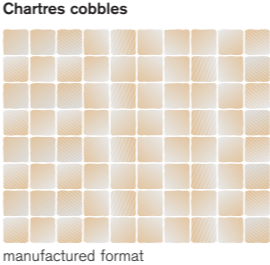
48 separate paving blocks (one layer) are used to provide 0.75m² of paving and are delivered in a standard laying pattern which can be varied to suit alternative designs. Chartres setts are manufactured in 60 and 80mm thicknesses.

Chartres boulevard paving offers an alternative to the often repetitive use of slabs and small element paving.

Chartres boulevard paving comes with a variable coursing width of 225 and 275mm. Each layer contains 12 separate paving blocks of 7 various sizes which are used to provide 0.775m² of paving and are delivered in a standard laying pattern which can be varied to suit alternative designs. Chartres boulevard paving is manufactured in a 70 or 80mm thickness as standard. A 100mm thickness is available to special order.

The Chartres Range is available with an olden or bush hammered finish in Purbeck, Cotswold or Traditional.

Chartres edging and Chartres starter circles have been specially designed to complement the Chartres range and are available in the same colours with an olden or bush hammered finish.



Product Summary

Use
Roads and footpaths on commercial, industrial and domestic sites.

Thickness
Chartres cobbles 60mm and 80mm.
Chartres setts 60 and 80mm.

Chartres paving 70 and 80mm (100mm are available to special order).

Spacing nibs
1.5mm nibs are incorporated within the block dimensions, to standardise joint widths.

Chartres edging
Chartres edging is specifically designed to provide a compatible edge restraint.

Chartres starter circles
are available to special order.

Aggregate/skid resistant
The blocks are available in normal aggregate or high skid resistant gritstone to special order see page 71.

Drawings
Detailed drawings of the Chartres range are illustrated on page 44.

Finishes and colours
Olden finish in three colours; Traditional, Purbeck or Cotswold.

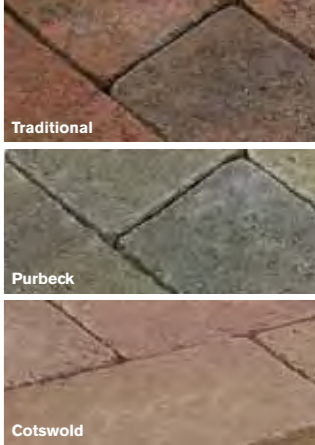
Special colours and a bush hammered finish are available to order.

Joint filling sand
See page 71.

per pack	thickness	
	60mm	80mm
Chartres cobbles		
square metres	11.2	8
number		
100x100mm	1120	800
weight tonnes	1.47	1.41
Chartres setts	60mm	80mm
square metre	10.5	7.5
number		
small blocks 100x100mm	126	90
medium blocks 150x100mm	406	290
large blocks 150x150mm	140	100
weight tonnes	1.38	1.31
Chartres boulevard paving*	70mm	80mm
square metre	9.30	7.75
number		
** mixed sizes	144	120
weight tonnes	1.43	1.37

* 100mm paving available to order

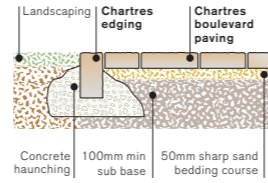
** see drawings on page 44



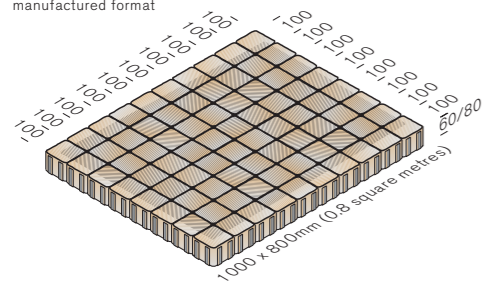
Cotswold Chartres starter circle and setts with an olden finish

See inside back cover for further information on colours and finishes

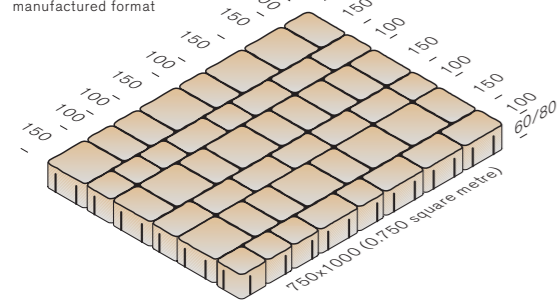
Chartres™ range cobbles • setts • boulevard paving



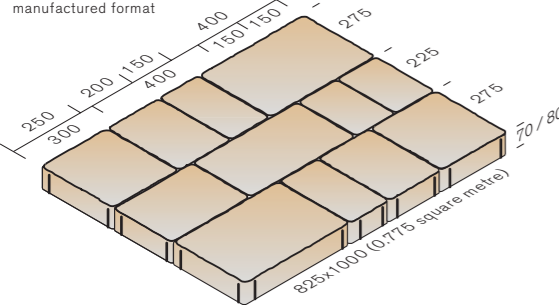
Chartres cobbles
manufactured format



Chartres setts
manufactured format

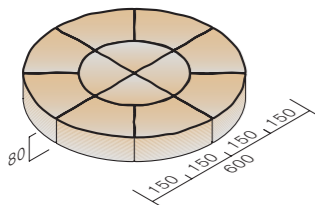


Chartres boulevard paving
manufactured format

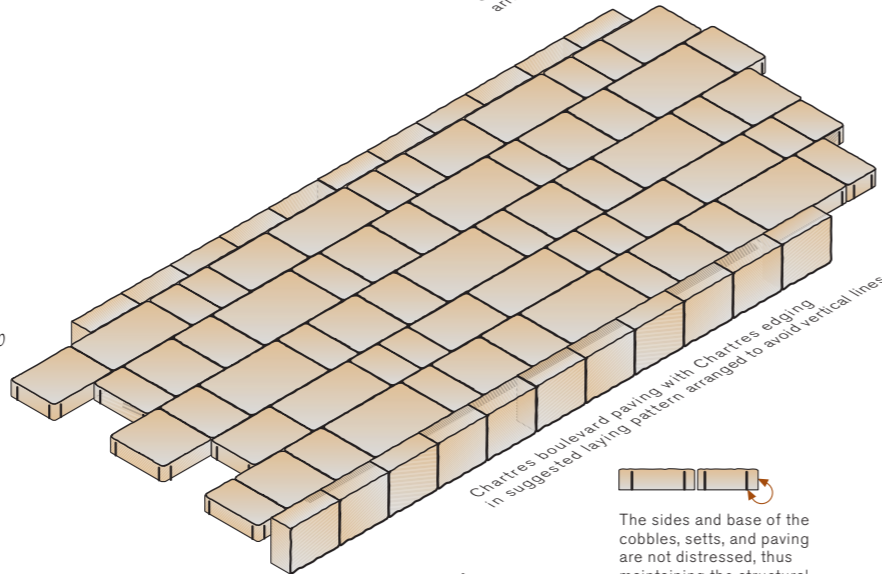
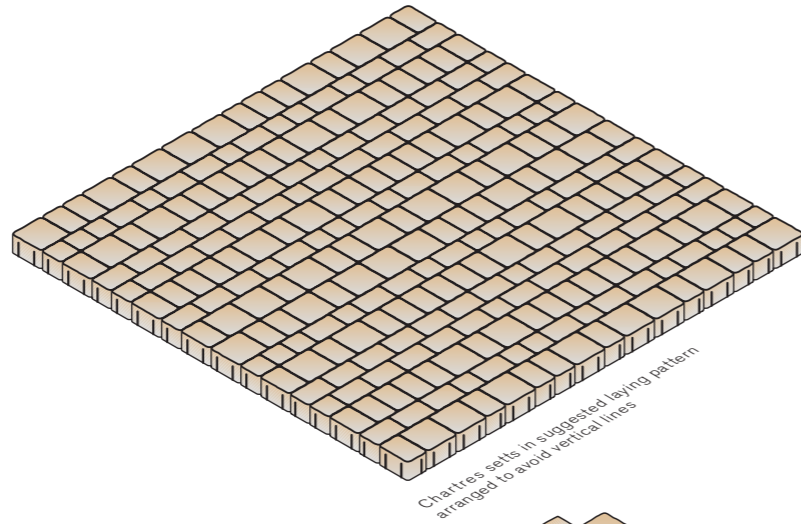
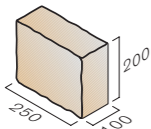


Chartres boulevard paving 70 or 80mm standard thickness, 100mm available to special order

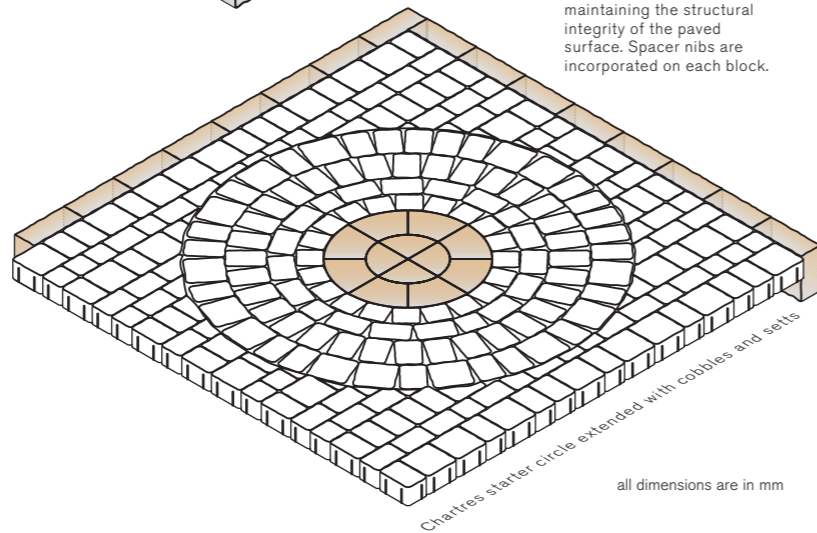
Chartres starter circle



Chartres edging



The sides and base of the cobbles, setts, and paving are not distressed, thus maintaining the structural integrity of the paved surface. Spacer nibs are incorporated on each block.



all dimensions are in mm



Chartres boulevard paving in Purbeck with an olden finish

Chartres boulevard paving in Purbeck with an olden finish

Chartres setts in Purbeck with an olden finish

Chartres setts in Traditional with an olden finish

Chartres boulevard paving with a bush hammered finish



Chartres cobbles, setts and boulevard paving in Pennant and Cotswold with an olden finish



Royal Forest™ range rectangular block paving • ancillary products

The Royal Forest range is suitable for use on projects as diverse as industrial loading areas, dock sides, pedestrian precincts and driveways. Available in a 50, 60 or 80mm depth in eight distinctive colours, the Royal Forest range is versatile enough to suit every situation.

The Royal Forest ML45 has been designed to complement the Hanson Formpave Royal Forest range with a machine layable paving block. Manufactured from concrete with a tensile splitting strength in accordance with BS EN 1338:2003 and with a 80mm thickness the Royal Forest ML45 is suitable for heavy-duty use including roads. A layer (1.28m²) consisting of 64 blocks is laid in one pass in a 45° herringbone pattern, enabling over 600m² per day to be readily achieved with a three man crew.



Royal Forest ML45 rectangular paving in Red brindle with a standard finish

Product Summary

Use
Roads and footpaths on commercial, industrial and domestic sites.
Hanson Formpave 60 and 80mm rectangular paving blocks conform to BS EN 1338.

Thickness
50, 60, 80 and 100mm. The 100mm thickness is available to special order.

Spacing nibs
1.5mm nibs are incorporated within the block dimensions, to standardise joint widths.

Chamfer
Each block has a chamfer on all top surfaces. A fine line chamfer block, for areas where trolleys are in use, is available to special order.

Aggregate/skid resistant
The blocks are available in normal aggregate or high skid resistant gritstone to special order, see page 71.

Drawings
Detailed drawings of the Standard paving range together with traditional laying patterns are illustrated on page 48.

Finishes and colours
Standard finish in eight colours.
Coated blocks in white, black or yellow for specialist applications are available to special order.

Special colours available to order. With the exception of the ML45, olden, bush hammered and EcoGranite finishes are available to order.

Joint filling sand
See page 71.

	thickness		
	50mm	60mm	80mm
Standard paving			
square metres	8.48	8.48	5.92
number 100x200mm	424	424	296
weight tonnes	0.933	1.10	1.04
ML45			80mm
square metres	—	—	8.96
number 100x200mm	—	—	448
weight tonnes	—	—	1.6



Standard finish



Fine line chamfer
*Special order
not available in ML45*



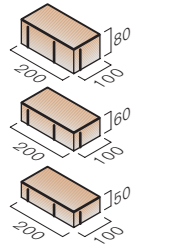
Bush hammered finish
*Special order
Not available in ML45*



Olden hammered finish
*Red brindle, other colours to
special order
Not available in ML45*

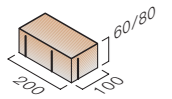
Royal Forest™ range rectangular block paving • ancillary products

Rectangular blocks

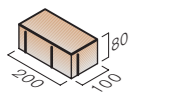


100mm available to special order

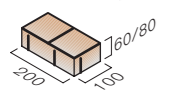
Fine chamfer blocks
available to special order



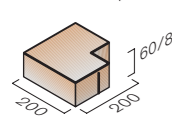
Royal Forest ML45



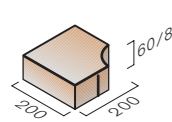
Stable block
available to special order



Post & Bollard Blocks
available to special order

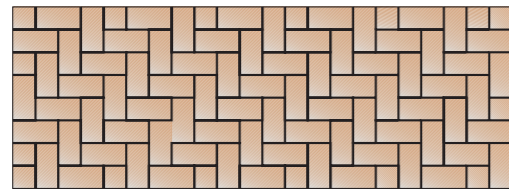


Square hole block
available in two hole sizes:
155x155mm nominal 150x150mm
205x205mm nominal 200x200mm

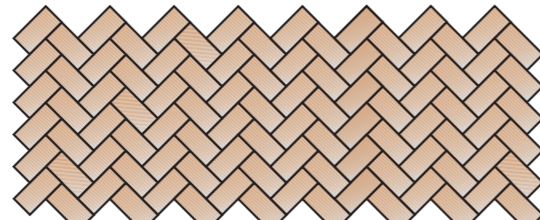


Round hole block
available in two hole sizes:
155mm diameter nominal 150mm
205mm diameter nominal 200mm

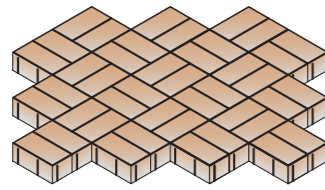
Laying patterns



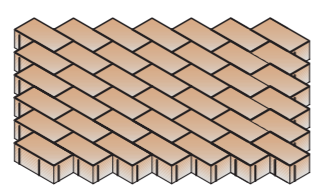
90° Herringbone



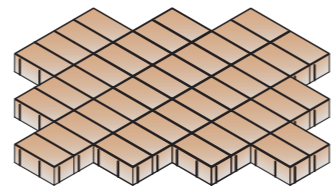
45° Herringbone



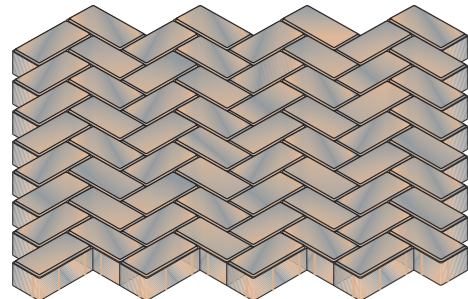
Basket weave



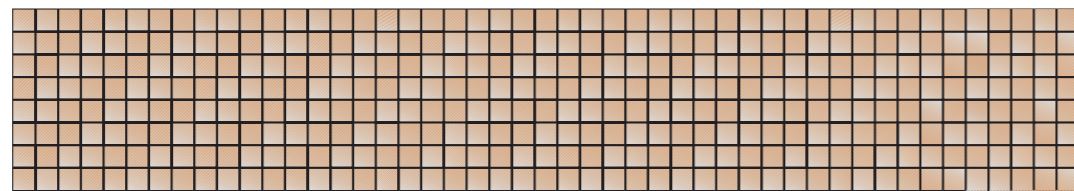
Stretcher bond



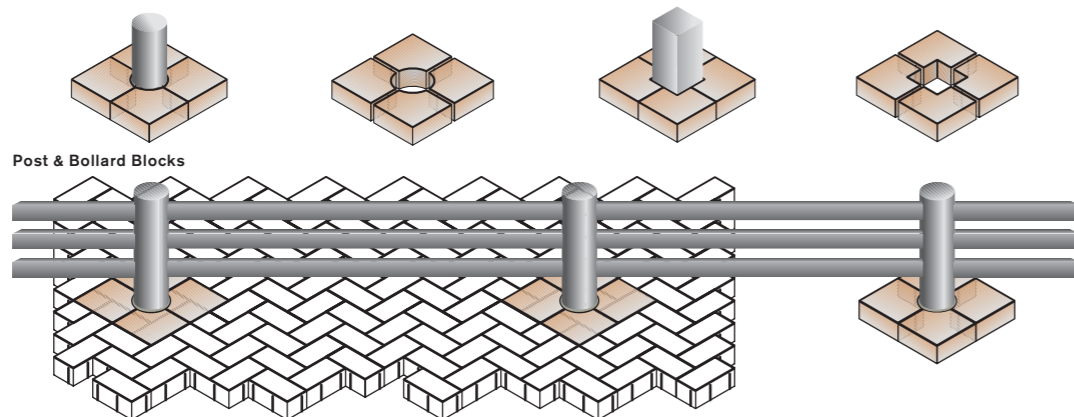
Stack bond



Royal Forest ML45 one pallet layer consisting of 64 blocks in a 45° herringbone pattern



Stable block in 90° Herringbone



Post & Bollard Blocks

all dimensions are in mm



Royal Forest rectangular paving in Burnt red and Charcoal grey with a standard finish



Royal Forest rectangular paving in Burnt red with a standard finish



Royal Forest rectangular paving in Red brindle with a standard finish



Royal Forest rectangular paving in Purbeck with a standard finish



Royal Forest rectangular paving in Burnt red, Natural, Purbeck, and Vendage with a standard finish



Royal Forest rectangular paving in Charcoal grey with a standard finish



Royal Forest rectangular paving in Burnt red and Charcoal grey with a standard finish



Royal Forest rectangular paving in Natural, Charcoal grey and Burnt red with a standard finish



Royal Forest rectangular paving in Burnt red and Charcoal grey with a standard finish



Royal Forest rectangular paving in Charcoal grey with a standard finish



Royal Forest rectangular paving in Red brindle and Charcoal grey with a standard finish

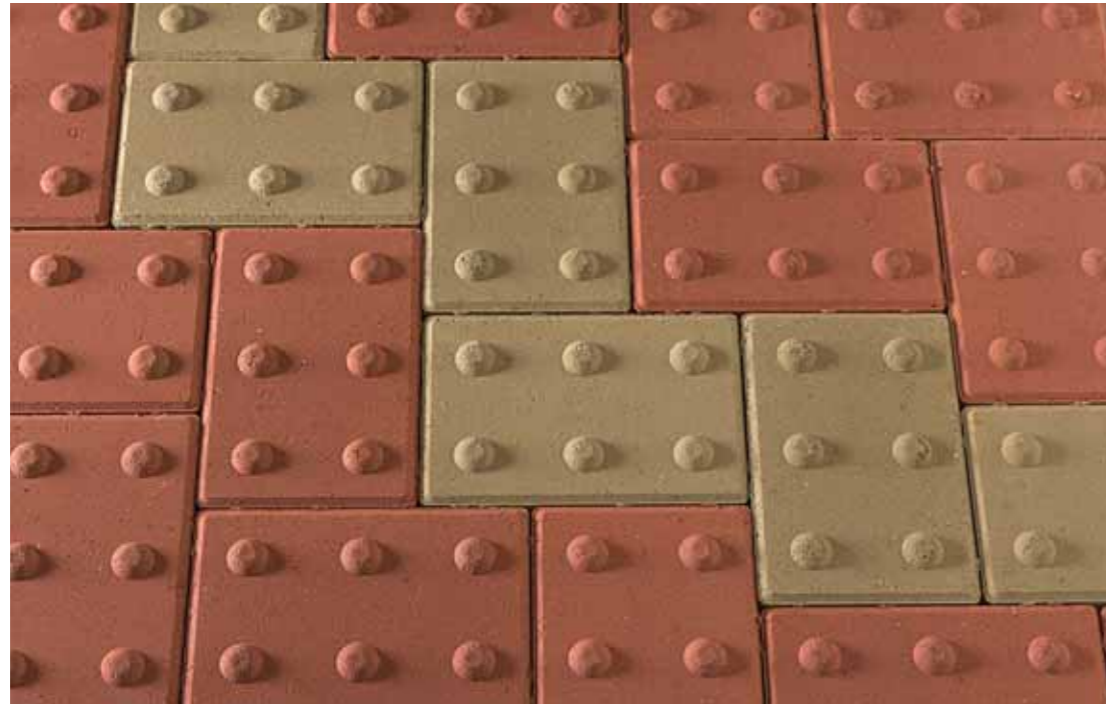
Tactile paving Royal Forest™ range

Small element paving Royal Forest™ range

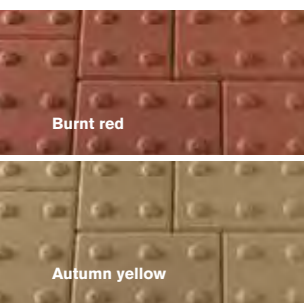
Available to special order

Product Summary

- Use**
Footpath crossings on commercial, industrial and domestic sites.
- Thickness**
60mm.
- Spacing nibs**
1.5mm nibs are incorporated within the block dimensions, to standardise joint widths.
- Chamfer**
Each block has a chamfer on all top surfaces.
- Aggregate**
Full strength concrete mix
- Finishes and colours**
Standard finish in Burnt red or Autumn yellow.
- Joint filling sand**
See page 71.



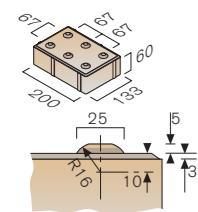
per pack	thickness
Tactile paving	60mm
square metres	7.98
number	133x200mm 300
weight tonnes	1.1



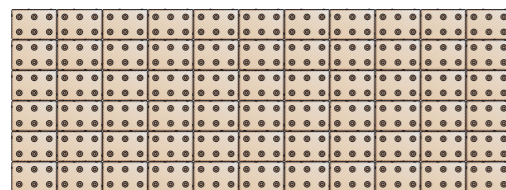
The tactile paver has been specially designed to overcome the breakage problems experienced by local authorities with larger element tactile paving.

The purpose of tactile paving is to provide a warning to visual impaired people. Visually impaired people would otherwise with the absence of a 25mm high kerb up stand, find it difficult to differentiate between where the footway ends and the carriageway begins.

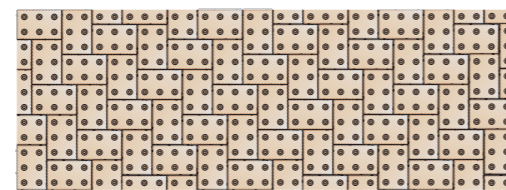
The surface is therefore an essential safety feature for this group of road users at pedestrian crossing points, where the footway is flush with carriageway to enable wheelchair users to cross unimpaired.



Tactile paving



Tactile paving in Stack bond



Tactile paving in Herringbone

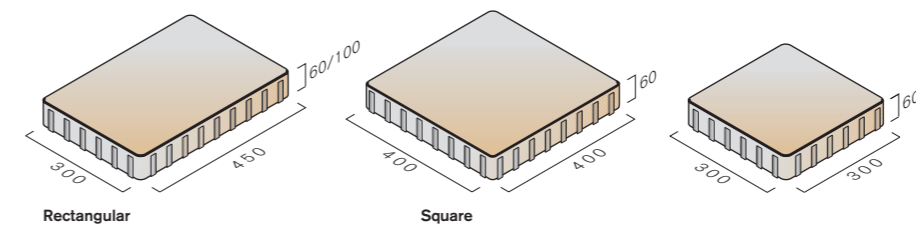


Product Summary

- Use**
Footpaths on commercial, industrial and domestic sites. All slabs conform to BS7263 Part 1 - 1990.
- Thickness**
Square and rectangular: 60mm.
100mm are available to special order.
- Spacing nibs**
1.5mm nibs are incorporated within the block dimensions, to standardise joint widths.
- Chamfer**
Each block has a chamfer on all top surfaces. A fine line chamfer block, for areas where trolleys are in use, is available to special order.
- Aggregate/skid resistant**
The blocks are available in normal aggregate or high skid resistant gritstone to special order, see page 71.
- Finishes and colours**
All colours and finishes are available to special order only.
See inside back cover.
- Joint filling sand**
See page 71.

Small element paving has been designed to work both in isolation and in conjunction with the Royal Forest range of paving, kerb and edge blocks.

Conventional square, stepped and diamond patterns can be easily created in either single or mixed colours. When used in conjunction with the Royal Forest range of paving, permutations are infinite.



Rectangular

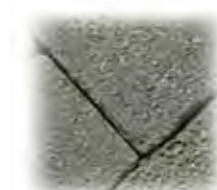
Square



Standard finish



Fine line chamfer



Bush hammered finish



Olden hammered finish



per pack	thickness	
Small element paving	60mm	100mm
rectangular	11.34	5.67
square metres		
number	84	42
300x450mm		
weight tonnes	1.49	1.23
square		
400x400mm	8.96	
square metres		
number	56	
weight tonnes	1.16	
square		
300x300mm	11.34	
square metres		
number	126	
weight tonnes	1.49	

above Small element square shown in Cotswold with bush hammered finish right Rectangular in EcoGranite Cornish Natural



Standard kerb in low rise position shown in Natural with Red brindle rectangular blocks



Bull nose kerb in Charcoal grey with a shot blasted finish. Shown with Royal Forest rectangular paving in Red brindle

Kerb systems

Two kerb systems are available, both are designed to work with the Aquaflo paving range, Royal Forest range of paving blocks and Small element paving.

Standard kerb and step system The standard range consists of eight blocks to facilitate edge restraint, cornering and cross-over. The standard kerb block may be used in both high and low profile or inverted to form steps.

Bull nose kerb system The Bull nose kerb system consists of four blocks and has been developed to provide a softer profile edge restraint. It is available in both standard (smooth) and textured finish as shown below in EcoGranite.

In addition to the kerb systems two edging blocks are available:

Chartres, EcoGranite and Royal Forest edging

A substantial edge restraint designed to complement each range in material, colour and texture. It can either be laid flush with block paving or as an upstand.

Forest edging Forest edging is a substantial all purpose edge restraint. It can either be laid flush with block paving or as an upstand. It is quicker and easier to lay than conventional kerb units and when laid flush with paved areas allows surface water to drain easily.

Product Summary

Use
Roads and footpaths on commercial, industrial and domestic sites.

Spacing nibs
Are not incorporated on the blocks.

Transition kerbs
Transition kerbs are available for the Bull nose kerb system as illustrated on page 56. For the Standard kerb system see pages 58.

Drawings
Detailed drawings of Edging and Forest edging are illustrated on page 57.

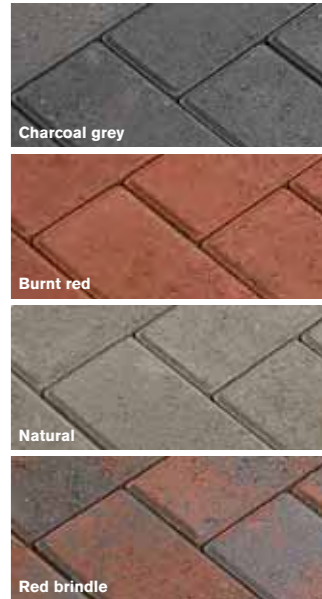
Standard kerb & step system are illustrated on page 55.

The Bull nose kerb system is illustrated on page 56.

Finishes and colours
Standard finish in four colours; Charcoal grey, Burnt red, Natural and Red brindle.
Coated blocks in white, black or yellow for specialist applications are available to special order.

Special colours and a shot blasted finish are available to order.

Joint filling sand
See page 71.



Standard kerb in high position shown in Red brindle with a standard finish



Bull nose kerb in EcoGranite Cornish natural



Standard finish



Shot blasted finish
special order



Bull nose kerb in Charcoal grey with a shot blasted finish



Forest edging in a standard finish



Standard kerb in high rise position shown in Charcoal grey with Chartres combined in Traditional



Standard kerb in low rise position shown in Natural with Red brindle rectangular blocks

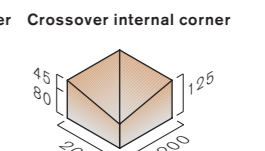
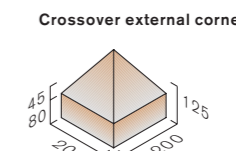
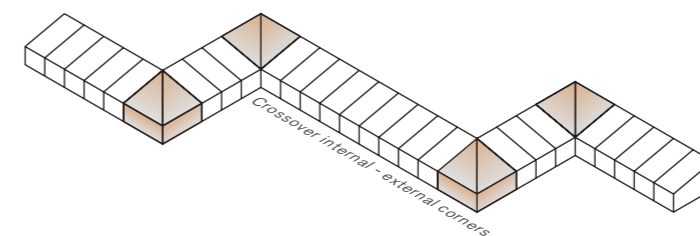
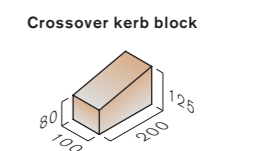
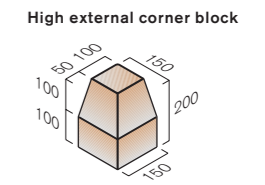
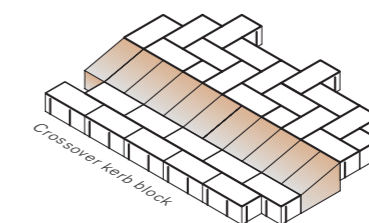
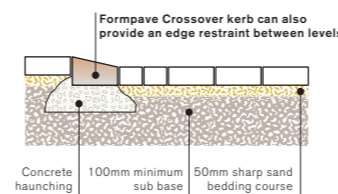
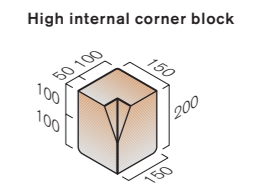
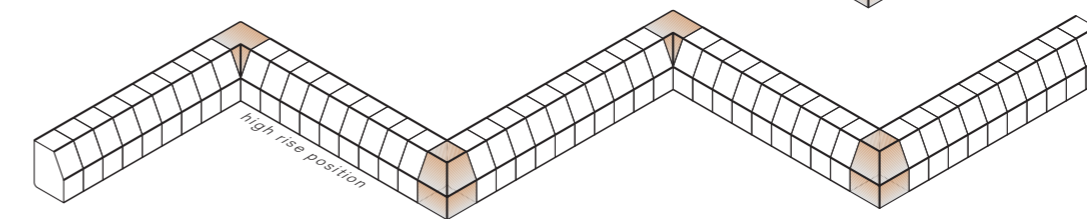
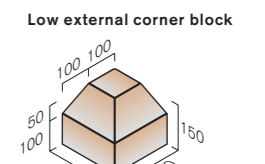
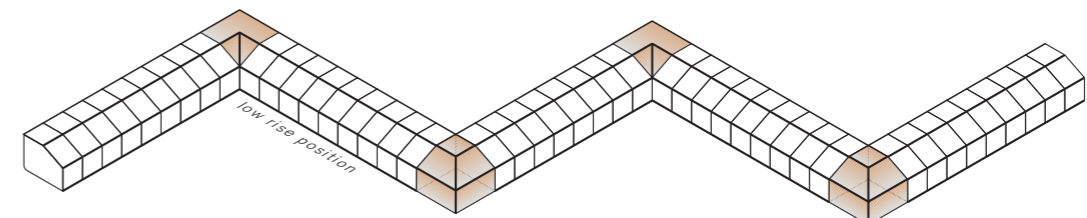
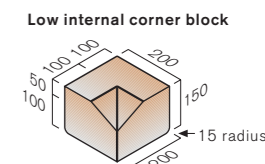
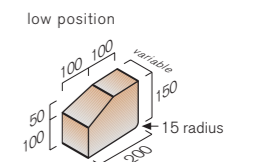
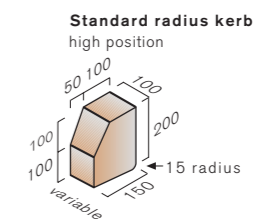
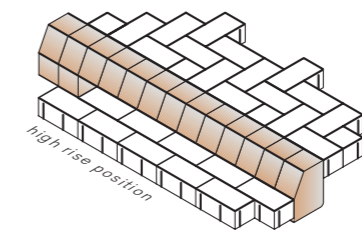
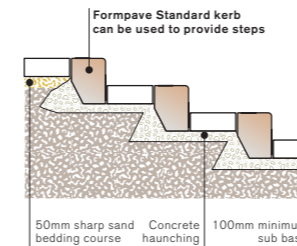
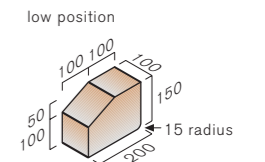
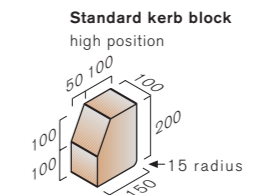
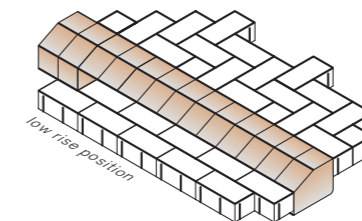
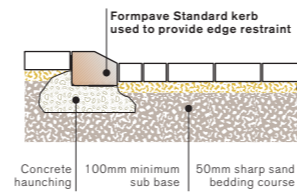


Standard kerb in low and high rise positions shown in Charcoal grey with external and internal corners right



Crossover kerb shown in Red brindle with Red brindle rectangular blocks

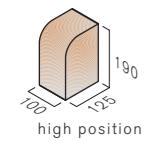
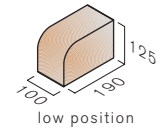
Standard kerb and step Kerb systems



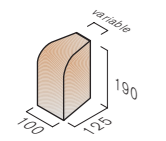
all dimensions are in mm

Bull nose Kerb systems

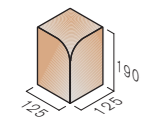
Bull nose kerb block



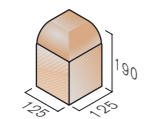
Bull nose radius kerb



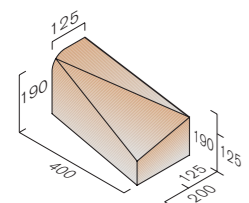
Bull nose internal corner



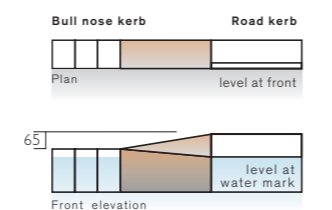
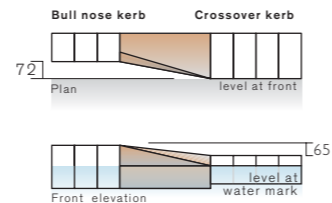
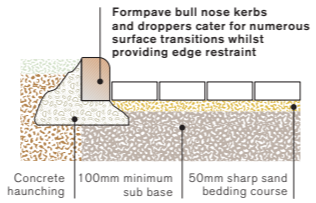
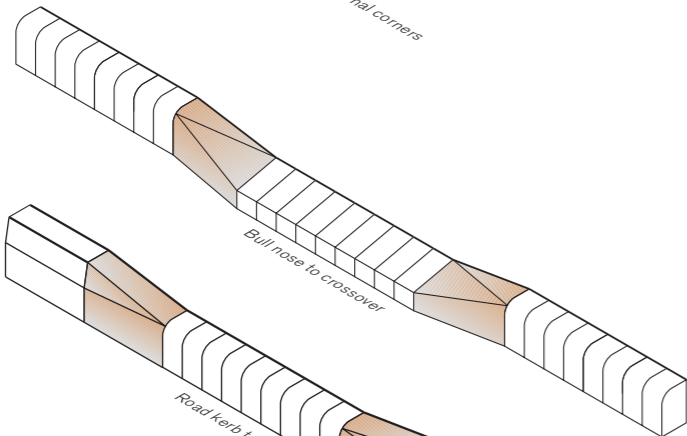
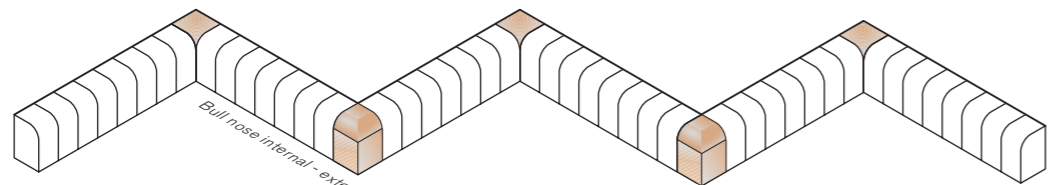
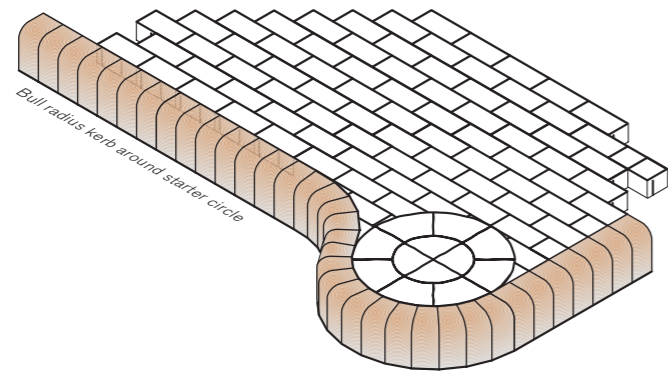
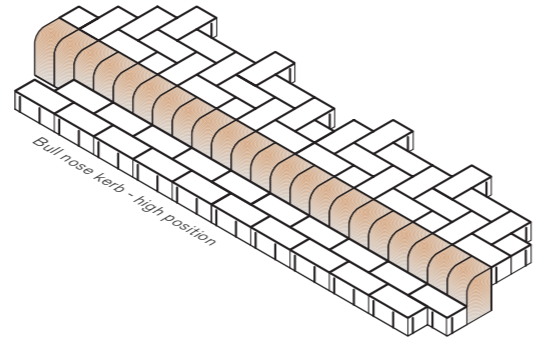
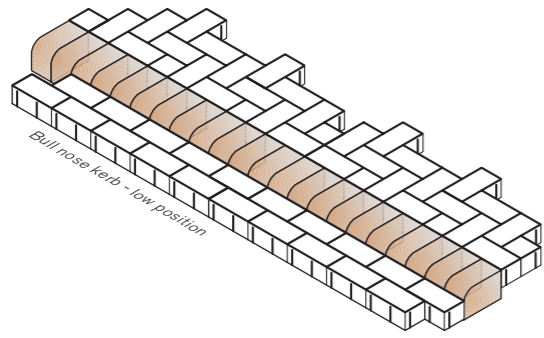
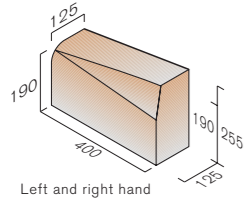
Bull nose external corner



Bull nose to crossover



Road kerb to bull nose

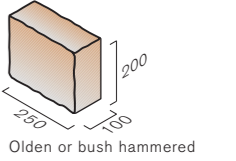


all dimensions are in mm

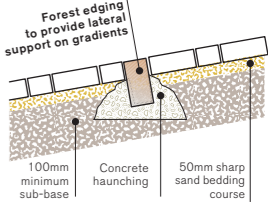
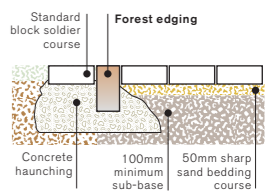
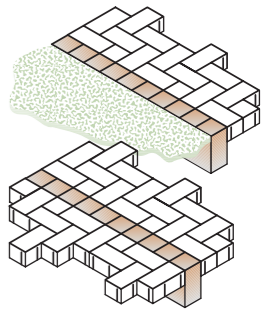
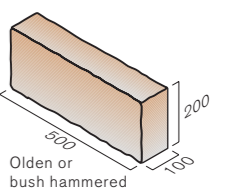
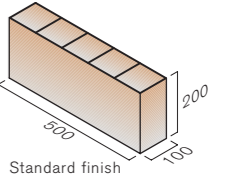


Edging Kerbs

Edging Chartres and EcoGranite



Forest edging

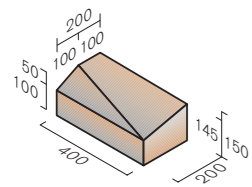


Where Forest edging is specified in an olden or bush hammered finish, the back and base of the unit is left intact with a standard finish.

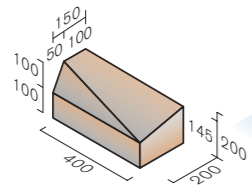
all dimensions are in mm

Transition kerbs Standard kerb system

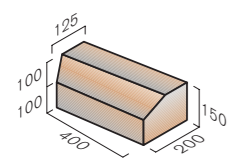
Low rise to Crossover



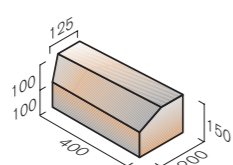
High rise to Crossover



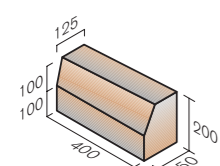
Low rise to Road kerb (type A)



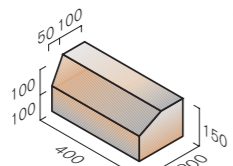
Low rise to Road kerb (type B)



Road kerb to High rise

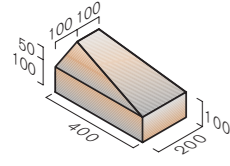


High rise kerb to Low rise



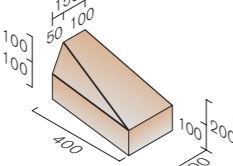
Dropper block low

Low rise to Standard block

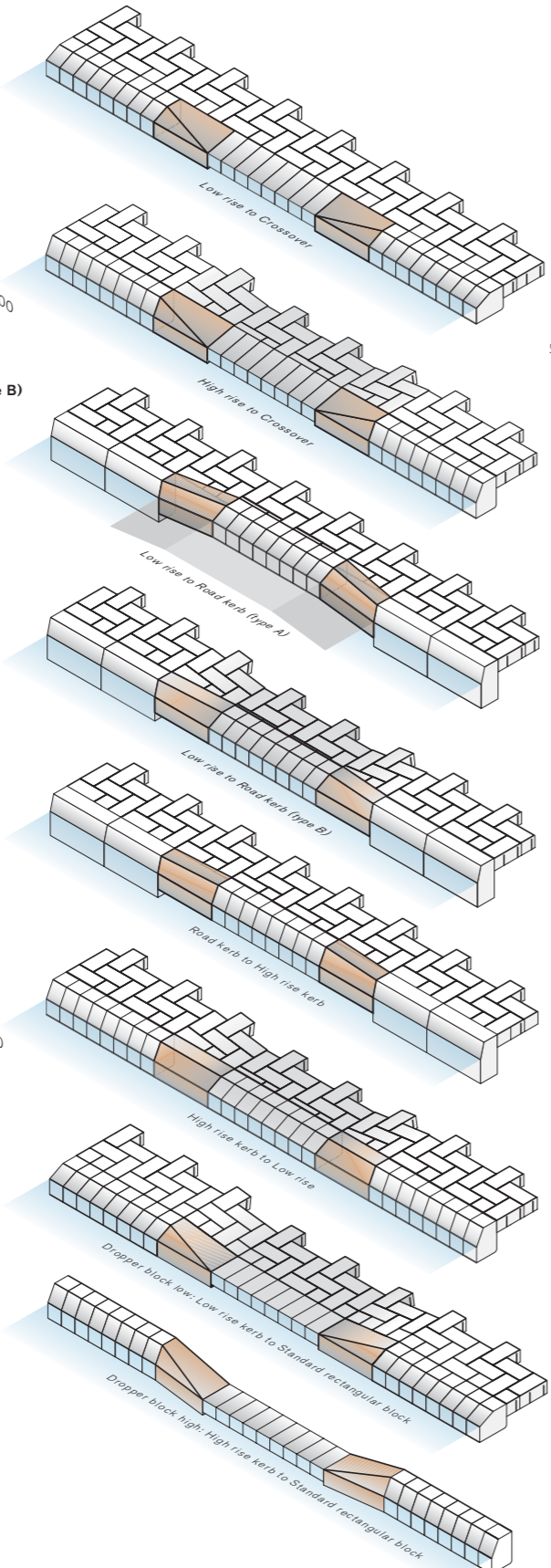


Dropper block high

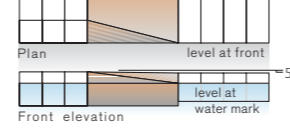
High rise to Standard block



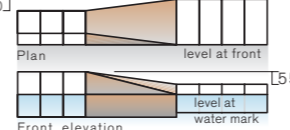
All transition kerbs are sold in pairs; left and right handed



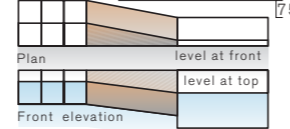
Low rise to Crossover



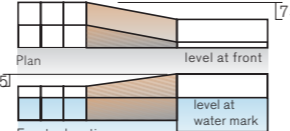
High rise to Crossover



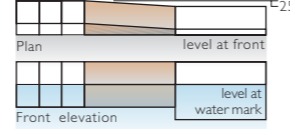
Low rise to Road kerb (type A)



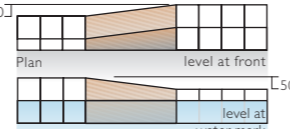
Low rise to Road kerb (type B)



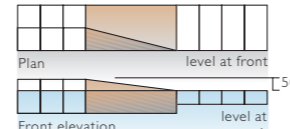
Road kerb to High rise



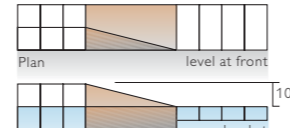
High rise kerb to Low rise



Dropper Low rise to Standard block



Dropper High rise to Standard block



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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

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

web-site: www.formpave.co.uk

Reference

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

Setting out

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

Aquaflow 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.

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 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 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 V _I H ₅₀	
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 rigid triangular 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 Intergrids. 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 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.



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	0.0375m ³
double	0.075m ³
triple	0.1125m ³

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.

Fin drain may be considered as a column of air that allows water the shortest, easiest and most effective passage from the surrounding sub-base to a dedicated outlet.

Top hat seal

Pre-formed seal to be sleeved 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.



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



Manufacturers of Inbitex



Manufacturers of SC Membrane



Manufacturers of SC Intergrid



Aggregates are available through:



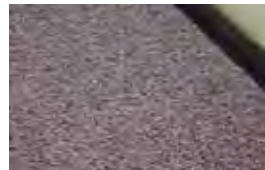
Hanson Aggregates for further information phone Formpave sales office 01594 836999

See web site for list of stockists.

Sub-base stone specification



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



Laying Course
50mm depth of 2-6mm, single size clean crushed stone to BS EN 13242:2002



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



Lower Layer
250mm depth 10 - 63mm clean crushed stone with well defined edges.

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

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 = 2.1
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
2-6mm	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
Distrubution 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 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.



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.

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 ISO 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.

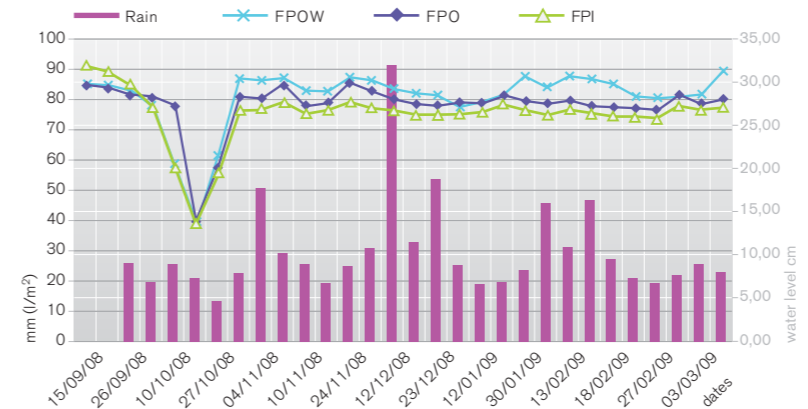
Research Authority	Contaminant	Concentration	Analysis method	
Coventry University 2008	Metals			
	Aluminium	0.100 mg/l	ICP-OES	
	Arsenic	0.002 mg/l	ICP-OES	
	Boron	Not detected	ICP-OES	
	Cadmium	Not detected	ICP-OES	
	Calcium	26.01 mg/l	ICP-OES	
	Copper	0.007 mg/l	ICP-OES	
	Iron	0.072 mg/l	ICP-OES	
	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		7.5-7.8 mg/l	O ₂ meter	
Electrical conductivity		≤350µS	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 2008 Severn Trent Laboratories 2008		Microbes		
			Concentration (organisms per ml of pavement water)	
	Acanthamoeba	0-5 /ml	Microscopy	
	E. coli	< 1 /ml	Selective media	
	Enterococci	< 1 /ml	Selective media	
	Heterotrophs	78 /ml	Selective media	
	Legionellae 3 key species	Undetectable	Selective media	
Edinburgh University 2007	Salmonellae & Shigellae	< 1 /ml	Selective media	

The field site at the University of Cantabria, Santander, Spain uses 10 full sized tanked 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.



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

TRL Report summary Project report PR/IP/106/01 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 Rein-statement 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.

240 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 uncompacted 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 D.2. 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 compaction 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 thickness 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 uncompacted 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 laid paving but stack at least 1 metre back from laying face. Do not allow plant to traverse areas of uncompacted 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 uncompacted areas of paving at the end of working periods, except within 1 metre of unrestrained 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 kiln 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 refill the joints as specified.

High skid resistance paving

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, Penkhull, Stoke-on-Trent ST4 7LQ

BS technical specification

Maintenance and care

Product	UPV	PPV	USRV	PSRV
Standard aggregate	76	60	71	57
Standard aggregate, Bush hammered	90	74	88	70
Gritstone aggregate	78	68	73	64
Gritstone aggregate, Bush hammered	92	77	87	73

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

BS technical specification

Paving blocks	Standard	Gritstone
Covered by BS EN 1338: 2003		
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 BS7263 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

Joint filling sand

Advisory service

Product development

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 kiln 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

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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.

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.

Please note: 'Natural' as used in Hanson Formpave products is not coloured with the aid of pigments. The colour is that of the raw materials used and may vary.

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

Samples

Sample blocks are available from your nearest Hanson Formpave Stockist or the sales office upon request.

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.

® Registered trademark
The following are registered trademark of Hanson Building Products Limited:

- Aquaflow
- Aquaflow ML
- Aquaflow MLE
- Aquaflow MLTB
- Aquaflow Themapave
- Aquapave
- Aquapaving
- Aquasett
- Aquaslab
- Formcell
- Formpave
- Formpave Aquaflow
- SC Intergrid
- SC Membrane
- Inbitex

™ Trademark

- EcoGranite
- Chartres range
- Royal Forest
- Royal Forest ML45

Patents

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

- AU 751257
- CA 2334571
- GB 2 338 969
- DE 1 095 189
- GG 2 338 969
- IE 1 095 189
- IT 1 095 189
- JE P688
- NL 1 095 189
- NZ 508786
- ES 1 095 189
- US 6 939 077
- BE 1 095 189
- AU 2002217305
- BE 1 373 640
- CA 2,431,629
- GB 1 373 640
- DE 1 373 640
- IE 1 373 640
- IT1 373 640
- NL 1 373 640
- NZ 526311
- ZA 2003/4637
- ES 1 373 640
- US 7 168 884
- AU 2005263879
- CA 2,557,220
- EP 05749142
- NZ 549583
- ZA 2006/07351
- US 10/594,705
- AU 2006212015
- CA 2,597,382
- EP 06709711.3
- GB 0602831.0
- NZ 556691
- ZA 2007/07217
- US 11/891,200

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Design service

All drawings provided by Hanson Formpave as part of their design service remain the property of the company and are protected by copyright and design rights. They should not be duplicated without permission from the Hanson Formpave design team.

Pack sizes







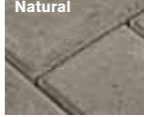

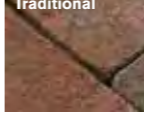


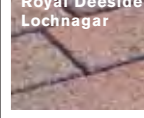
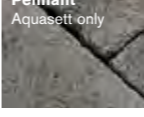
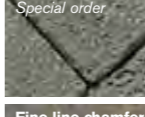
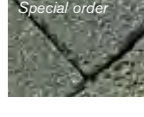
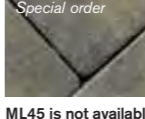
Pack sizes may vary according to manufacturing location, please check with sales office.

Specifications

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.

design: Tony Baldaro fsca, Preston, Bath, England print: Philpotts Litho Ltd, Bristol, England materials cover: Revine 50/50 white 1-sided board for: Revine 75 white matt

Aquaflow permeable paving	Chartres classic modular paving	Chartres cobbles • setts • boulevard paving	Royal Foreset	Tactile paving	Small element paving special order	Kerb systems and Edging	EcoGranite
 Charcoal <i>Not available in Aquasett</i>	 Charcoal <i>Chartres large only</i>		 Charcoal		 Charcoal	 Charcoal	 Cornish Natural
 Burnt red <i>Not available in Aquasett</i>			 Burnt red	 Burnt red	 Burnt red	 Burnt red	 Cornish Tintagel
 Golden brindle <i>Not available in Aquasett</i>			 Golden brindle		 Golden brindle		 Cornish Truro
 Natural <i>Not available in Aquasett</i>			 Natural		 Natural	 Natural	 Royal Deeside Balmoral
 Red brindle <i>Entire range including Aquasett</i>			 Red brindle		 Red brindle	 Red brindle	 Royal Deeside Braemar
 Traditional <i>Aquasett only</i>	 Traditional	 Traditional					 Royal Deeside Victoria
 Vendage <i>Aquasett only</i>	 Vendage		 Vendage		 Vendage		 Royal Deeside Lochnagar
 Pennant <i>Aquasett only</i>	 Pennant						
 Aquaflow permeable paving is also available EcoGranite with the exception of Aquaflow ML45, ML, MLE and MLTB. See right hand column for colours.	 Purbeck	 Purbeck	 Purbeck		 Purbeck		
	 Cotswold	 Cotswold	 Autumn yellow	 Autumn yellow			
			 Royal Foreset is also available EcoGranite with the exception of ML45. See right hand column for colours.				
 Standard finish <i>Not available in Aquasett</i>			 Standard finish		 Standard finish	 Standard finish	
 Olden finish <i>Aquasett only</i>	 Olden finish	 Olden finish	 Olden finish <i>Red brindle, other colours to special order</i>		 Olden finish		
 Bush hammered <i>Special order</i>	 Bush hammered <i>Special order</i>	 Bush hammered <i>Special order</i>	 Bush hammered <i>Special order</i>		 Bush hammered <i>Special order</i>	 Shot blasted <i>Special order</i>	 Bush hammered
 Aquaflow ML45, ML, MLE and MLTB are not available in a Bush hammered finish.			 Fine line chamfer <i>Special order</i>		 Fine line chamfer <i>Special order</i>		
			 ML45 is not available Fine line chamfer, Bush hammered or Olden finish.				

