pave-it

news from interpave

May 2006 › issue seven

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the latest news from Interpave focusing on precast concrete paving

large scale

Pave-It finds out about some of the largest block paving projects in the world and how they were achieved

environmentally sound

we look at the latest developments in concrete block permeable pavements – for large and small projects

winning designs

the latest US paving awards offer some useful lessons in the use of colour, texture and pattern

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NEW

- Review of the new Code of Practice for block laying
- Interactive guide to sourcing laying and jointing material
- Current status of British Standards for precast concrete paving

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pave-it contents

cover pictures
above: concrete block paving at the Port of Felixstowe – the largest container port in the UK – full story on page 7.
below: bold use of coloured paving in Miami, Florida – more American winners on pages 14/15.

about Interpave

Interpave – the Precast Concrete Paving & Kerb Association – represents the leading manufacturers of concrete paving blocks, flags and kerbs. Its main objective is to expand the use of these materials through education, technical and marketing campaigns.

Interpave is a product association of the British Precast Concrete Federation.

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welcome...

to the 'big' issue of Pave-It

It could be argued that there are two sides to paving – technical performance and aesthetic appeal – with engineers looking after the former and urban, landscape or architectural designers the latter. Precast concrete paving offers real opportunities in both areas, usually in combination for most projects. But in this issue we look at opposite ends of the spectrum to see what can be learned.

In China, we examine probably the largest block paving project in the world (page 6) – and one of the most demanding applications where performance is everything – alongside a similar application here in the UK for the same client. In contrast, on pages 14-15 we review the American paving design awards which highlight just how much can be achieved with precast concrete paving design in terms of colour, texture, pattern and innovation.

But there is also another ingredient to add – sustainability. We make no apology for more coverage of concrete block permeable pavements (CBPP) in this issue. CBPP technology is moving ahead all the time, expanding its range of applications. In this issue, we discuss large scale and innovative projects (pages 8-9) as well as heavy-duty applications (pages 10–11) and of course there is no reason why CBPP cannot incorporate lively designs just like other precast concrete paving.

Thanks for your feedback on previous issues – do keep your comments, suggestions and project stories coming. If you do not already receive your own copy of Pave-It, just visit **www.paving.org.uk** to register now.

John Howe
Interpave

Interpave's John Howe renewing an old friendship with Ge Wei Jun, Block Pavement Maintenance foreman at Yantian International Container Terminals, China (see page 6).

news »»

Interpave has published an important document 'Permeable Paving Projects – Concrete Block Permeable Pavement Case Studies and Update' to complement its earlier introductory brochure and its design guide. It contains the very latest information on permeable pavements, including project case studies demonstrating a wide range of applications and exploring the expanding scope of this sustainable technology.

In addition to flood prevention, designers are discovering far more benefits and using the technology in different ways to meet a wide range of particular demands – not necessarily as part of a Sustainable Drainage System (SUDS) management train but often as stand-alone solutions. The case studies illustrate different applications and demands of CBPPs including use on sloping sites and immediately adjacent to buildings. They also demonstrate alternative drainage solutions including stand-alone infiltration to the ground, or forming part of the SUDS management train with important ecological and wildlife benefits.
These aspects are explored in more depth on pages 8-9.

The 12-page Update and other information on Concrete Block Permeable Pavements are available free of charge from Interpave or as PDF downloads from the website **www.paving.org.uk.**

Interpave
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how much?

Leading consultants Scott Wilson Pavement Engineering Ltd are finalising extensive Initial Cost and Whole Life Cost Analyses commissioned by Interpave. These independent reports will compare precast concrete paving with asphalt and in situ concrete pavement constructions for a range of applications and subgrade conditions.

Once completed, the full reports will be available on the Interpave website, as well as a summary document.

website resource

The Interpave website **www.paving.org.uk** has been substantially expanded again following a rapid increase in usage - maintaining its role as the essential detailed information resource on precast concrete paving and kerbs for civil engineers, architects, landscape designers, contractors and all those involved with the paved environment.

The COMMERCIAL section of the website now contains a series of detailed design, construction and maintenance guides covering all aspects of concrete block paving – including permeable pavements – flags and kerbs, bringing together the very latest standards and industry experience. As a new feature, complete manuals can now be downloaded for paving blocks, permeable paving, flags or kerbs. Alternatively, individual PDF downloads are available, each covering – where appropriate – Properties, Structural Design, Detailing, Handling, Construction and Reinstatement.

The updated Commercial section of the website also includes the latest information on applications of particular importance today such as urban regeneration, accessible paving, home zones and permeable pavements.

source resource

Another important new facility on the Interpave website is the interactive laying and jointing material section. In addition to guidance on material specification for different types of precast paving – including permeable pavements – it provides the latest details of where particular materials can be sourced, related to geographical locations.

all change for paving standards

The block paving installation Code of Practice BS 7533 Part 3 has been extensively revised – as discussed on page 13. This is just one example of the changes going on with Standards for paving now and over the next few years. It is essential that designers and contractors keep up to date so we have also included a new 'Summary of Standards' PDF download on the Interpave website. Here you will find a table summarising the 19 British Standards that apply to precast concrete paving. Not only does this tell you what version is current but it also schedules the standards to be written or amended. The same web page also contains a PDF download reviewing the changes to BS 7533 Part 3.

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sustainable front gardens

The Royal Horticultural Society's campaign to improve front gardens raises an important issue about the effects of paving on rainwater drainage into the ground. Demands for off-street parking and legislative pressures for accessible routes to homes points in the direction of hard surfaces. However, as the RHS guide shows, the right sort of paving can actually help this situation – in particular concrete block permeable pavements. They provide a structural pavement suitable for parking cars and even lorries, but, at the same time, allow water to pass straight through into the layers beneath for temporary storage, then into the ground. Alternatively, the water can be collected below and used for irrigation of gardens to keep them green. As the RHS guide also points out, allowing the water to pass through can also help avoid clay soils shrinking, which could have consequences for garden walls and houses.

Interpave is in discussion with the RHS about a number of initiatives to promote domestic use of permeable paving. We are also supporting garden design students from Devon's Bicton College with their show garden at the West Country Garden Festival in Exeter (14-16th July). This will promote an attractive, alternative way to show that the front garden can be much more than a solid paved area. It will include permeable paving and accommodate both a vehicle and planting, whilst taking into account the effect on the wildlife and the environment.

major paving projects

the big issue

The world's largest container terminal operator Hutchison Port Holdings (HPH) is probably the biggest user of concrete block paving around the world. Interpave looks at two very different HPH projects to see how concrete block pavements can provide a long-term solution on very large, heavy-duty applications.

Yantian International Container Terminals

(YICT) in the Peoples Republic of China is one of the fastest growing container ports in the world. The rapid economic development of this region has created a surge in container traffic, particularly with manufactured goods being shipped worldwide. YICT is a joint venture between HPH and the Shenzhen Yantian Port Group.

In terms of throughput, the facility handled 13,000 TEU* in 1994, its opening year. Less than ten years later in 2003, YICT registered an annual throughput of 5.3 million TEU. Working around the clock, YICT serves 35 of the world's top shipping companies. To ensure that capacity keeps pace with demand, YICT accelerated the terminal's Phase III development project comprising four 9,000+ TEU berths and 800,000 m² of block pavements.

- 20 December 1998 – throughput exceeded one million TEU's
- 21 August 2000 – handled its 5 millionth container
- 24 May 2002 – handled its 10 millionth container
- April 2005 – won the title: 'Best Container Terminal in China' from China Ports Association Container Branch

essential quality assurance

Phase II commenced in 1997 and was completed in 1999. It consisted of a quay deck, 500,000 m² of block paved container yard and supporting infrastructure. The senior management of YICT were fully committed to ensuring high quality and compliance with the specification and were prepared to "partner" and assist the Mainland Chinese contractor to achieve this. Quality control procedures and on-site testing for all aspects of the works, including pavement construction and structures, were developed by the YICT Site Engineers to monitor and ensure compliance with the specification. These procedures were an amalgamation of Chinese, British and Australian standards and best practice. YICT employed and trained Site Supervisors to supervise the works and assist the contractor in achieving the client's objectives. For the pavement construction, YICT undertook training of the contractor's engineers and operatives. This approach proved crucial with the hectic activity on site so that quality control and inspection exceeded that expected in the UK.
For example, no settlement was experienced around service/drainage pits, due to the rigorous requirements for compaction and testing of every pavement layer. YICT have also set up a small team who undertake continuing minor repairs to the pavements.

The project's performance is testament to YICT's commitment to quality. The expertise, knowledge and methods developed, together with the experience gained by site staff, were put to good use for the construction of Phase III. For both phases, paving blocks were manufactured locally but made and tested to British Standards.
As labour is cheap and readily available, much of the construction was undertaken by manual labour and not by machines.
For example, the sub-base material was blended, mixed and levelled on site by a large gang of labourers. Blocks were laid manually with productivity levels of up to 1500 m² /day. Laying course and jointing materials were screened manually prior to use.

The completed pavements in Phase II and III now have containers stacked five or more high and are used by conventional trucks and container fork-lifts with axle loads of 90 tonne, as well as solid rubber tyre port vehicles which apply higher loads to the pavement than similar vehicle with pneumatic tyres. In addition, over 150 massive eight-wheeled 'rubber tyred gantry cranes' (RTGs) with wheel loads in the order of 27 tonnes per wheel regularly run and turn on the block paving, when traversing between the RTG runways, without problems.

Because the whole site comprised of general fill material with some mud pools, it was expected that there would be both settlement and differential settlement. Block pavements can tolerate this well and, to date, settlements have been minor.
This minor settlement can be attributed to the Chinese designers' method of dealing with such problems during the design stage of the project. They specified that the fill material was to be compacted by dynamic compaction – i.e. dropping weights of up to 20 tonnes, from a height of 25 metres by crane and rock filling and compacting the indentations. This is a slow but very effective method of compaction and minimising future settlement.

continuing growth and improvement

YICT continues to improve operations and is regarded as one of the worlds most efficient ports. During 2005 it was also one of the busiest in Southern China handling 67 regular shipping services to major ports in the US, Europe, Australia, South Africa and Asia. To keep pace, further huge areas are planned starting with the Phase III Expansion – 1,300,000 m² of concrete block pavements – due to commence shortly.

Thanks to YICT for providing information and assistance with this article.

* TEU is the 'Twenty foot Equivalent Unit', effectively the volume occupied by a single standard 20ft container.

major paving projects

Port of Felixstowe

– a member of the Hutchison Port Holdings Group (HPH) – is already the largest container port in the UK and one of the largest ports in Europe. Concrete block pavements have been used extensively for the last 20 years and continue to be installed.

In December 2002, work started on a civil engineering contract worth £28 million to construct a major extension to the Port's Trinity Terminal which was completed in two years. The works included 230,000 m² of concrete block paved container storage yard. Considerations for its construction were rigorous, with all aspects of the project focused on bringing best practice to the job, including both materials used and health and safety, to achieve the Port's goal. The challenge was to find a solution that would offer assurances of laying consistency and, on completion, would provide the Port with a durable surface able to cope with the continual movements of heavy container-handling equipment and stacked container loads.

When considering the surfacing products, it was also important that suppliers and the main contractor engaged in long-term thinking rather than simply fulfilling short-term aims. The cheapest material could not be assumed to be the most cost–effective solution. Meeting the engineering and aesthetic demands of the project was a critical factor, with the emphasis on whole-life costing of the product and issues of sustainability. Added to this were a life-cycle requirement of 20 years or more and the need for maintenance to be simple and infrequent, keeping efficiency at the highest levels.

Much of the block paving was installed using innovative mechanical laying techniques, following extensive trials in partnership with a specialist paving contractor. Here the contractor used a German machine specifically designed to lay block paving. The blocks were packaged in a 45-degree herringbone formation, with each machine clamp picking up and laying 64 blocks (1.28 m²) at a time.

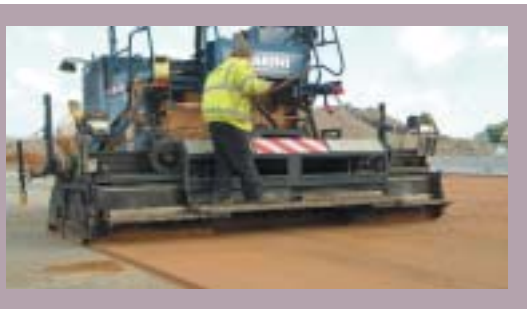
The speed and efficiency of the mechanical laying techniques enabled vast areas of block paving to be laid by a minimal number of skilled operatives, in a safe and controlled manner. In addition to stacked containers, the completed area is used by a variety of vehicles including large forklift trucks and 16-wheel rubber tyred gantry-cranes (RTGs) with wheel loads of 14 tonnes. The concrete block paving has demonstrated its ability to withstand the constant movement and load impacts of varied goods that are stored at such a major container port. Another stage of the Port expansion commenced in late 2005 with a further 50,000 m² of block paving. The method of block construction is similar to the previous stage except that the blocks are configured in 90-degree herringbone pattern.

Looking to the future, the recently approved Felixstowe South Reconfiguration will see conversion of the Port's original Dock Basin - an area previously used by ferries - and the existing Landguard Terminal into a new deep-sea container terminal. The development will include 1,350 metres of quay with an additional 13 ship-to-shore gantry cranes. It is expected that the first phase of the new terminal, providing another 750,000 m² of block paved container yard, will commence operation in

2008. The completed development, together with the earlier extension of the Port's Trinity Terminal, will enable Felixstowe to provide a total of over four kilometres of deep-water container facilities and the total capacity of the Port will increase by 1.5 million TEUs, to 5.2 million TEUs per annum.

THE VERY LATEST...

Work continues with machine laying of blocks. The sand laying course is now installed over lean-mix concrete with a paver machine. This has a sonic sensor (shown at the left in the photo) controlling the screed box to ensure a constant thickness.



slow it down... clean it up

Concrete Block Permeable Pavement (CBPP) technology has moved on from being novel and experimental to established and mainstream today, forming part of planning guidance and building regulations, as well as the draft Code for Sustainable Housing discussed opposite. But at the same time designers are discovering far more benefits than just runoff attenuation, using CBPPs in different ways to meet a wider range of demands – not necessarily as part of a SUDS management train but often as stand-alone solutions.

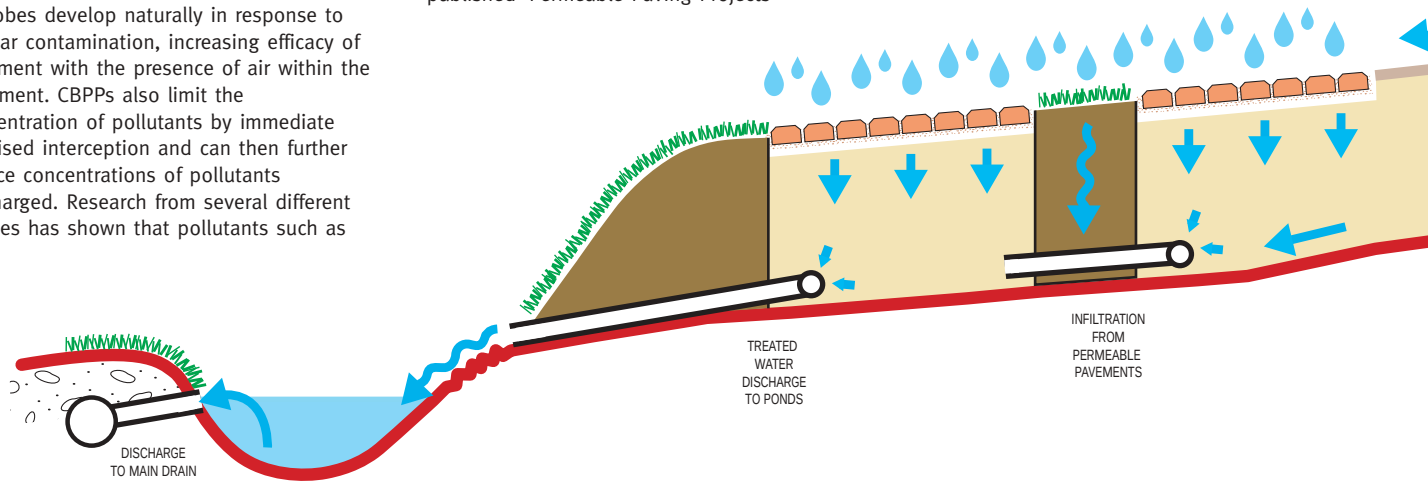
CBPP is used right up to the building at the Hazeley School and roof drainage discharges into the permeable pavement.

For over two decades, CBPPs have been used extensively in a number of countries and their performance monitored. Interpave's 'Permeable Pavements – Guide to the Design, Construction and Maintenance of Concrete Block Permeable Pavements' provides tried and tested guidance based on substantial experience. This experience clearly demonstrates the suitability of CBPPs for very large schemes (such as the Northampton project opposite) as well as the heaviest duty situations including ports and container terminals (discussed later on pages 10/11). It also highlights the essential role played by CBPPs not only in attenuating runoff but also in removing pollutants, revolutionising the possibilities of this technology.

There is now a clearer understanding of the role played by CBPP in handling polluted water – either as part of a SUDS train or in isolation. It is accepted that specialised microbes develop naturally in response to regular contamination, increasing efficacy of treatment with the presence of air within the pavement. CBPPs also limit the concentration of pollutants by immediate localised interception and can then further reduce concentrations of pollutants discharged. Research from several different studies has shown that pollutants such as heavy metals, nitrogen, phosphorus and hydrocarbons are effectively removed from water by permeable pavements.

CBPPs offer an important capability, particularly at the head of the SUDS train, to handle catastrophic incidents such as spillages and can negate the need for interceptors (with their inherent maintenance demands). CBPPs with no infiltration to subgrade (System C) can be used for effective treatment with only minimal additional 'polishing' treatment from other SUDS devices. This approach has been used at the new Hazeley School in Milton Keynes. Here, the inherent absence of gulleys and other traps with CBPPs also has a real impact on protecting wildlife – including 'protected' species. Interpave has recently published 'Permeable Paving Projects – Concrete Block Permeable Pavement Case Studies and Update' illustrating different applications and demands of CBPPs including use on sloping sites and adjacent to buildings, such as the Hazeley School. The document demonstrates alternative drainage methods of stand-alone infiltration to the ground (as at Martlesham Park and Ride, Ipswich, also discussed later), or as part of the SUDS management train.

The Interpave Update and Case Study document as well as the Design and Construction guide are available from Interpave on 0116 253 6161 or can be downloaded from **www.paving.org.uk**



the permeable pages

northampton brownfield initiative

In Northampton, over 50,000 m² of CBPP attenuates and treats surface water before discharge to watercourses (photo courtesy of Mowlem plc).

Another interesting example of a concrete block permeable pavement (CBPP) being used to slow down and clean up runoff before discharge – this time to water courses – is nearing completion on a brownfield site in Northampton. And at over 50,000 m² this was Europe's largest CBPP project started last year.

The Northampton Brownfield Initiative, a partnership between English Partnerships and Northampton Borough Council, is transforming various sites to create new homes and leisure facilities. A 2,235 car and coach park with access roads forms an essential part of this development. This is being constructed over old gravel pits previously filled with household waste and capped off with a clay capping layer many metres thick. In order to minimise future settlement it was necessary to reduce the clay capping layer to half a metre thick and apply high-energy ground compaction techniques. Because the capping layer had been reduced it was necessary to build a pavement that would not allow any water to infiltrate into the existing ground.

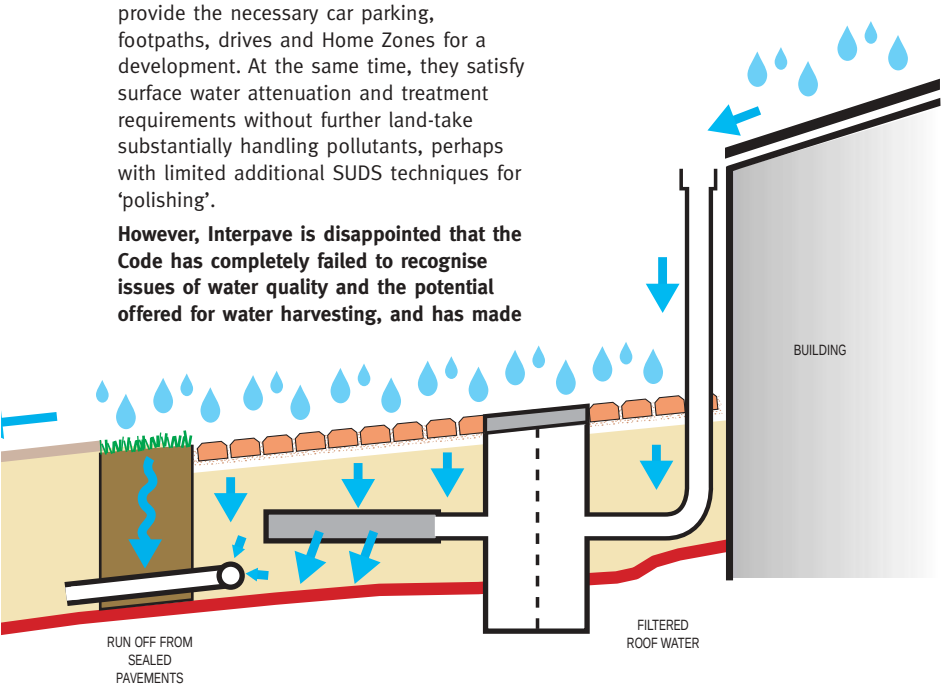
Concrete block permeable pavements with no infiltration (System C) installed by principal contractor Mowlem, used for parking areas and roads allow for the complete capture of all water, as well as attenuation and treatment within the pavement. The water captured by the pavement is then either discharged into drainage ditches or directly into the River Nene. Due to the pollution removal characteristics of CBPPs it was not necessary to provide oil separators. The CBPP roads are being adopted by the local authority. Thanks to Mowlem plc for providing information and assistance with this article.

sustainable code

The December 2005 draft of the government's 'Code for Sustainable Homes' clearly recognises SUDS as a means to achieve the minimum standard for 'Surface Water Management', one of the six 'Essential Elements' identified. The draft Code also points out that SUDS are generally no more expensive than traditional pipe drainage while issues of land-take and compliance with requirements for higher density influence drainage design for housing more than cost. Here, CBPPs can provide the necessary car parking, footpaths, drives and Home Zones for a development. At the same time, they satisfy surface water attenuation and treatment requirements without further land-take substantially handling pollutants, perhaps with limited additional SUDS techniques for 'polishing'.

However, Interpave is disappointed that the Code has completely failed to recognise issues of water quality and the potential offered for water harvesting, and has made formal representations to the government.

The new BRE EcoHomes programme takes a similar approach. These omissions are surprising as SUDS techniques such as CBPP are encouraged for these very reasons in the government's planning policy document PPS23. Permeable pavements have the ability to make substantial improvements to water quality by a combination of filtration and microbiological action – a major sustainability benefit. They can also handle run-off from other impermeable paved areas and from roofs.



At the Hazeley School, Milton Keynes, runoff from roofs and impermeable surfaces, as well as the CBPP itself is treated within a series of terraced permeable pavements. The treated water flows into ponds inhabited by wildlife including Great Crested Newts, a protected species.

"Developers should be encouraged where appropriate to incorporate into their proposals SUDS that are able to absorb at source, the run-off from various types of development, including car parks, buildings, paved areas and roads, or to store water for non-drinking water use or enabling it to be released more slowly. This will help to reduce the impact of diffuse pollution from that run-off and flooding, as well as providing a contribution to local amenity and biodiversity." – PPS 23: 'Pollution Control, Air and Water Quality.'

While permeable pavements are recognised by Approved Document H (Drainage & waste disposal) it still permits water to be directed to a drainage system or watercourse as an alternative to the use of permeable pavements or free-draining areas, in cases where these techniques are said to be difficult to apply. This is not sustainable. Although for most areas in the UK the underlying clay has low permeability, it is nevertheless possible to design for water to infiltrate into the soil or to be collected for re-use (perhaps as irrigation) or eventually allowed into the next stage of the management train or into conventional drainage systems, watercourses or reservoirs. This approach has significant benefits for water supply, attenuation and quality.

Interpave considers that the emphasis of the Code requirements should be on:

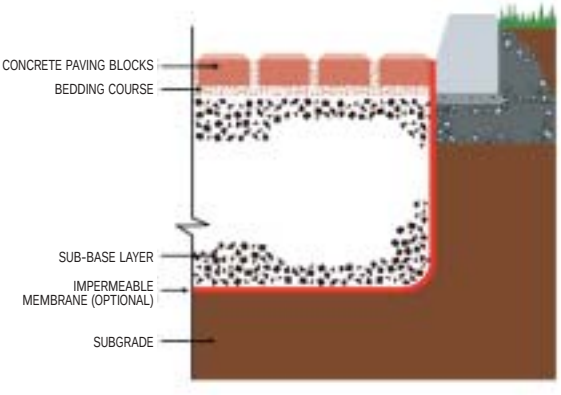
- Re-use of water on-site to achieving discharge from a site less than that prior to development
- Attenuation of the discharge
- Improvement to water quality discharged from site
- Improving and creating ecology
- Minimising land take to accommodate SUDS systems

the permeable pages

heavy duty sustainability

John Knapton

John Knapton is a consulting civil and structural engineer having spent his career both in consulting and in academia. In 2002, he retired from the Chair of Structural Engineering at Newcastle University to focus entirely upon consulting, whilst maintaining a Visiting Chair at Liverpool University. He has been involved in the design of over 30 SUDS projects involving Permeable Pavements in Ireland and more recently in the UK. He was engaged by Interpave to develop design guidance for its Technical Manual.



Permeable pavements have been in service for many years but, so far, few have been used in heavily trafficked situations. This is because experience of highway or industrial traffic on permeable pavements has been limited: engineers have felt uncomfortable about the concept of allowing vehicles to use pavements whose roadbase comprises coarse graded stone with maybe 30% voids for use as a reservoir. However, recent experience of the use of concrete block permeable pavements (CBPP) has demonstrated their ability to sustain significant loading, both in terms of high axle loads and frequency of trafficking.

At Santos, rectangular paving blocks with oversize spacers were used as the surface to the permeable pavement.

I have been designing heavy duty, concrete block permeable pavements for several years, using a design method subsequently adopted by Interpave with excellent results. My first heavy duty permeable pavement was at Santos Container Port, Brazil, where 'Reach Stackers' lifting 40ft containers apply axle loads of 100 tonnes. The pavement was installed over sand which 'Falling Head Permeameter' testing showed to have excellent infiltration characteristics. In order to sustain regular trafficking by the Reach Stackers, the upper part of the 20mm to 5mm clean stone roadbase was stabilised with 7% cement by weight.

Since that time, I have designed many permeable pavements in retail developments

Completion of the permeable paving at Santos Container Port, Brazil.

to surface the car park and the delivery access road. In particular, I frequently specify permeable paving at loading docks where heavy lorries track over exactly the same point in the pavement for each delivery. With a typical example in Dublin the upper part of the 20mm to 5mm clean stone was cement stabilised in order to withstand the effects of Large Goods Vehicles.

I have also carried out a number of site and laboratory trials to establish the suitability of permeable pavements for heavily trafficked pavements. Using the Newcastle University Rolling Load Facility (NUROLF)

the permeable pages

This sub-angular cement-treated roadbase was installed at a retail project in Dublin. Although the cement formed only a thin film layer coating the particles, it added significantly to the strength of the pavement.

I established that permeable pavements could withstand upwards of 100,000 standard axles without developing undue deformation. I undertook trafficking of both water-filled clean stone and also of dry roadbase material and found that the best results were obtained with paving blocks bedded in 6mm/3mm grit over 20mm/5mm stone. I also carried out site trials – mainly to demonstrate the stability of the clean stone. Such material is self-compacting and remains loose at the surface so that it appears to be unsuited to traffic. However, when paving blocks are installed over the stone, their weight provides the requisite stability so the clean stone becomes stable.

One such trial was carried out at a Park & Ride facility at Martlesham, Ipswich (discussed on page 8). Concern was expressed that the clean stone would not remain stable in service as vehicles soon became trapped in the material itself.

However, a trial demonstrated that the same truck was able to traffic the permeable pavement repetitively without causing deformation or deflection.

Based upon my experience, I developed design procedures for trafficked permeable pavements which have been included in the Interpave design guide. Traditionally, highway pavement loading has been assessed in terms of the number of 8000kg Equivalent Standard Axles (ESA's) which a pavement will be required to withstand throughout its life. The loads applied to a pavement usually differ significantly from 8000kg but research has shown that axles of other load values can be equivalenced to standard ones. The Fourth Power Law is often used to equivalence a given axle load to a standard axle. In the case of permeable pavements, an alternative approach is required: one which assesses loading in terms of the maximum load which a pavement can be expected to withstand.

The reason for this alternative approach is that permeable pavements are designed on the basis of ultimate limit state analysis rather than serviceability limit state analysis.

The truck used in the Martlesham trial became trapped in the clean stone after a few passes but the installation of CBPP created a stable pavement.

Conventionally, a pavement fails by becoming gradually unserviceable – by developing ruts progressively, for example. A permeable pavement, on the other hand, needs to be designed to ensure that it is stable. An under-designed permeable pavement could fail catastrophically when a load was applied because the materials used in the structure have less stability than those used in a conventional pavement. For this reason, the conventional ultimate limit state design approach is adopted. In this approach, firstly loads are predicted and multiplied by a load safety factor which reflects the degree of accuracy of the prediction. Secondly, material strength is measured and is divided by a material safety factor which reflects the level of consistency which can be expected for that material. The NUROLF results indicated that, even when water is cascading through the pavement, the materials used in the test can withstand repetitive axle loads. This result is used as the basis for the derivation of the Interpave design approach.

The technical manual *'Permeable Pavements, Guide to the Design, Construction and Maintenance of Concrete Block Permeable Pavements'* is available from Interpave on 0116 253 6161 or can be downloaded from **www.paving.org.uk.**

BS 7533 : Part 3 : 2005

laying standard updated

The Code of practice for laying precast concrete paving blocks and clay pavers for flexible pavements, BS 7533 : Part 3 : 2005, has been extensively revised and amended following a long consultation period, and came into effect on 20th October 2005.

All formal British Standards are developed with a period of public enquiry and consultation, utilising expertise from a wide range of sources including academics, special interest groups, consumers, business and industry – including, of course, Interpave and Interlay. The resulting standards represent a consensus on current best practice.

Unlike the Building Regulations, British Standards are not mandatory but they do offer important guidance. They are also generally accepted as the preferred method of work and often referred to in specifications, so it is important that designers and contractors are fully up-to-date with the latest versions. Unless a specification stipulates a particular edition of a Code, the latest version is deemed to apply. Interlay members have already been made aware of the changes, as the Interlay Code of Practice clearly states that work carried out by members should be undertaken in accordance with the relevant British Standards – particularly BS 7533 Part 3.

The most important development in the revised standard is inclusion of requirements for permeable pavement construction, recognising its rapid growth in popularity. These additions include:

- **Sub-base and road base** – for permeable pavements, 'Type 1' material should not be used: grading requirements for materials that allow water to percolate through are included.
- **Surface gradients** – permeable pavements may be constructed with zero gradients.
- **Laying course** – The grading of laying course material for conventional and permeable pavements is different. Permeable pavement laying course material is designed to allow water to pass through quickly and consists of larger, nominally single-size aggregate. Experience has shown that angular shaped particles perform better than rounded material and the same grading is used for both the laying course and joint filling material.
- **Joints** – permeable pavements typically have joints greater than 6 mm.
- **Protection** – It is essential that any soil, fine material and other materials that arise during construction should be prevented from contaminating the pavement surface. This is to ensure the material in the joints remains free draining, ensuring the pavement remains permeable throughout its design life.

Pavement Construction Flow Chart from BS 7533-3.

Other changes not specific to permeable pavements include an update of product specifications to meet the European standards. The aggregate size and grading of the laying course and jointing materials for conventional pavements has not changed but the grading analysis is now assessed in accordance with the new sieve sizes given in the BS EN standard.

The procedure for pavement construction has been detailed in the form of a useful flow chart giving the chronological order of construction, including cleaning the area before compaction and self-assessment of the area for compliance before the application of jointing material and after final compaction.

For conventional pavements the final compacted thickness of the laying course material should now be 30 mm regardless of whether over sub-base or roadbase material. For permeable pavements a 50mm compacted thickness applies.

Interpave has reviewed the revised standard as published and produced a document (available to download from **www.paving.org.uk**) to highlight the most important changes and revisions over the previous edition.

paving the world

the american way

The winning projects from this year's 'North American Decorative and Durable Concrete Pavement Design' contest give a clear demonstration of the bold design approach being taken in the USA with hard landscaping. They are also a timely reminder of the huge aesthetic potential of precast concrete for urban designers in terms of colour, texture, pattern and scale. With the opportunities of the 2012 Olympics and the current trend towards shared hard surfaces requiring demarcation and delineation without physical barriers, perhaps there are lessons for us here?

A tidal flow of precast concrete paving leads visitors to the National Aquarium in Baltimore, Maryland – a key harbour-side attraction (Winner, Commercial Category).

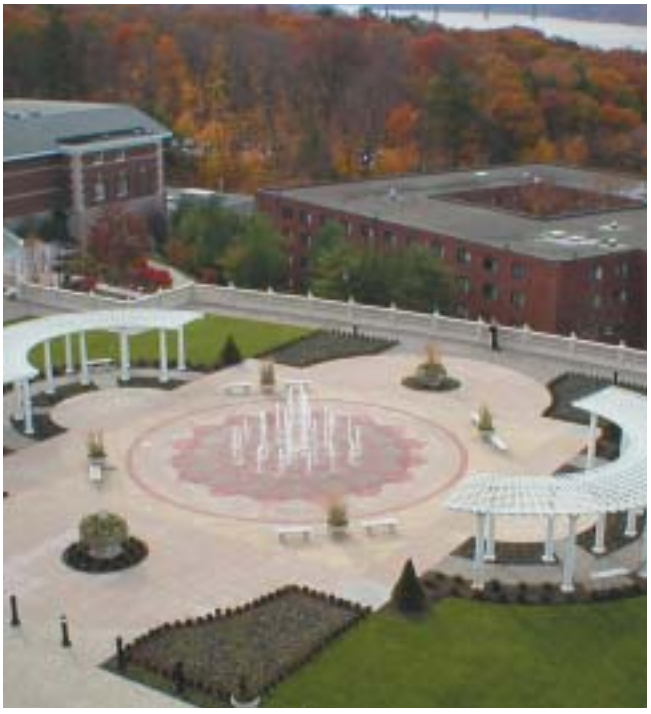
Colourful renovation of a dilapidated street in the historic Little Havana area of Miami, Florida celebrates the game of dominoes and enlivens the surroundings (Second Place, Commercial Category).

Pastel colours complementing the local Art Deco architecture and flowing lines characterise this beach-side walk at South Beach, Miami (Honourable Mention).

paving the world

Surface treatment exposes glass and other special aggregates in the paving at this tribe-owned shopping centre in Hollywood, Florida (Honourable Mention).

A smart, formal design using a subtle palette of paving flag colours is used for this plaza in front of apartments in Baltimore, Maryland (Honourable Mention).



Paving flags in a complex, swirling 'Spirograph' pattern on a campus plaza for the Culinary Institute of America in New York (Joint Winner, Speciality Category).

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