CI/SfB (90.4) F
September 2004

Marshalls

PRIORA PERMEABLE PAVING DESIGN GUIDE

www.marshalls.co.uk/drainage

Marshalls plc is the UK's leading manufacturer of superior concrete, clay and natural stone products which transform landscapes and redefine the built environment. With more than 120 years' experience, Marshalls expertise in materials sourcing, manufacturing, distribution, technical advice and customer service is respected within the industry, making us the preferred supplier for prestigious projects including Trafalgar Square, London; Trafford Centre, Manchester and the Falkirk Wheel, Scotland.

As a truly customer focused organisation, Marshalls commitment to delivering and exceeding client satisfaction throughout the supply chain is our priority. Product innovation is at the heart of our business, ensuring our customers have access to a comprehensive and enviable product portfolio to complete their landscaping requirements, from paving, block paving, kerb and drainage to street furniture.

Injecting innovation into new product development and investing in revolutionary manufacturing techniques cements Marshalls market leading position. Our vision, to deliver the products customers want, on time, every time, is supported by Marshalls teams of design, technical and customer service experts, ensuring Marshalls can service clients' needs from project and design conception right the way through to installation and maintenance.

As a major plc, Marshalls was recently rated as the UK's 37th most admired company, and as a group its expert companies have become the Landscape sector's benchmark for excellence. Marshalls is committed to quality in everything it does, offering its customers honesty, integrity and experience for total peace of mind.

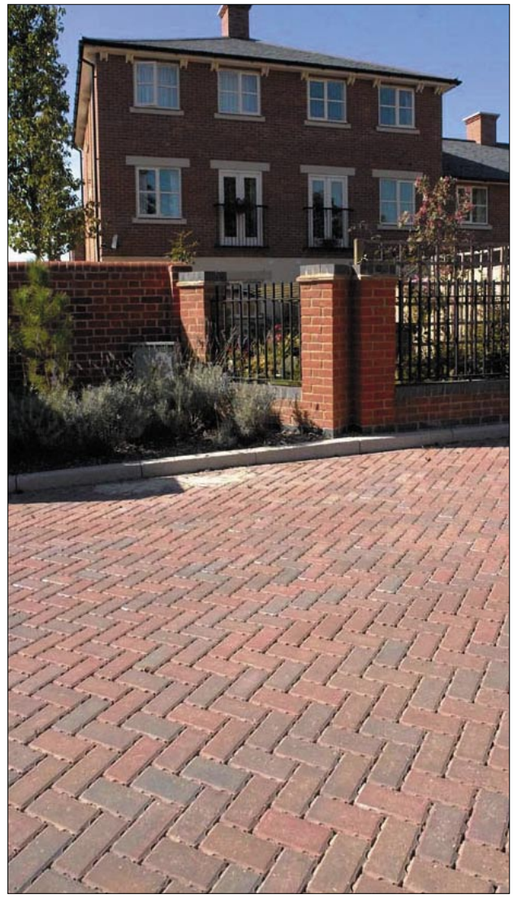
CONTENTS

THE BENEFITS

PRIORA PERMEABLE PAVING
Priora is Marshalls permeable paving solution for use in Sustainable Drainage Systems (SuDS) and schemes. Priora is an innovative paving system which, coupled with a specific design methodology and sub-base specification allows surface water to be controlled at source. Water can be drained directly into the ground, recharging the ground water whilst also controlling the surface water runoff at source.

The use of Marshalls Priora offers the following benefits:

- High load bearing capacity due to the unique interlocking characteristics. The system can withstand the dynamic stresses offered by vehicular trafficking and point loads.
- Large drainage openings allowing the efficient infiltration of surface water runoff.
- Lasting surface water infiltration capacity due to the unique layout of the interlocking spacer profiles.
- A variety of laying patterns are possible.
- Conservation of space on the site, allowing the needs and requirements of both PPG3 and PPG25 to be achieved.
- Reduction of surface water runoff by as much as 100% for infiltration sites.
- Increased recharge of groundwater.
- Allowing new developments in areas restricted by current surface water drainage constraints.
- Reduced overall project development costs owing to a reduction in storm sewers and drainage accessories.
- The filtering and removal of metals and suspended solids in any surface water.
- The development of bacteriological breakdown of any hydrocarbons entering the sub-base.



Berkeley Homes, Knowle Village, Fareham

Ferrymuir Centre, Edinburgh

DESIGN SERVICE

DESIGN SERVICE
Marshalls Technical department offers a free bespoke design for Priora on any project where a permeable pavement is being considered.

When we are designing a permeable pavement, two aspects of the pavement design are considered. These are the structural performance and the hydraulic capability of the pavement. Both of these designs will provide a depth of open graded sub-base, with the greater thickness leading the design.

The following criteria are considered in our designs:

Hydraulic Design

- Catchment characteristics
- Ground conditions
- Site topography
- Rainfall characteristics
- Environment Agency Restrictions

Structural Design

- Type and Frequency of traffic
- CBR Values

Marshalls Technical Team will produce as many feasible design solutions as possible. This is intended to allow the contractor to identify possible benefits and cost savings associated with the alternative designs.

Depending on the above factors, the final design will be either an infiltration, partial-infiltration or a non-infiltration system.

Ocean Fields, Glasgow

Mclean Garden, Stonehouse, Lanarkshire

Colourtop Priora, Martlesham Park & Ride, Ipswich used for marking out disabled parking bays

THE PRIORA SYSTEM

THE PRIORA BLOCK

Priora blocks are produced in a 200 x 100mm rectangular module 180mm deep with a patented interlocking joint.

The structural interlocking capability is achieved by having a joint profile offering protruding nibs. These interlock throughout the depth of the block and when jointed, prevent any displacement, both laterally and vertically, under heavy loadings and dynamic stresses providing the pavement's design is suitable for the intended purpose. This allows loads to be initially distributed over a larger area, reducing the stresses being exposed to the sub-layers.

The unique joint profile allows the surface water to infiltrate into the pavement and its sub-layers.

The use of the laying course material as a jointing material not only reduces the number of differently graded materials being used, but due to the grading profile allows the aggregate to fully fill the joints enhancing the integrity and interlock offered by the paved system.

Priora Block, Natural

LAYING PATTERNS

The unique spacer nib profile allows the blocks to be installed to the following patterns. Marshalls would recommend the following advice offered in British Standard BS7533: Part 3: 1997; Code of practice for laying precast concrete paving blocks and clay pavers for flexible pavements, regarding the application of different laying patterns.

Basketweave

Running Bond

Herringbone

The blocks comply with BS EN1338: 2003 (Concrete paving blocks – Requirements and test methods) and are available in the following colours.

Charcoal

Natural

Buff

Marigold*

Red

Burnt Ochre

Brindle

White Colourtop

Precise colour and surface texture should be judged from actual materials rather than photographic representations.

* Manufactured to order, minimum quantity 500m^2

THE PRIORA SYSTEM

LAYING COURSE

The large size of the innovative sub-base material aggregate creates an uneven surface when compacted and has an open textured surface. The laying course material provides a flatter platform onto which the blocks are laid, (fig 1) this prevents any rocking or instability of the blocks in-situ. The same material is also used as the jointing material for the system (fig 2). The material should meet the following grading:

LAYING COURSE GRADING	
RECOMMENDED BS EN 13242 AGGREGATE (mm)	2/6.3
RECOMMENDED BS EN 13242 GRADING/TOLERANCE CATEGORY	GTc20/15
SIEVE SIZE (mm)	PERCENTAGE BY MASS PASSING ISO 565 SIEVE
31.5	100
20	100
14	100
10	100
6.3	80 to 99
4	20 to 70 (±15)
2	0 to 20
3.15	
2.8	0 to 5

Fig. 1

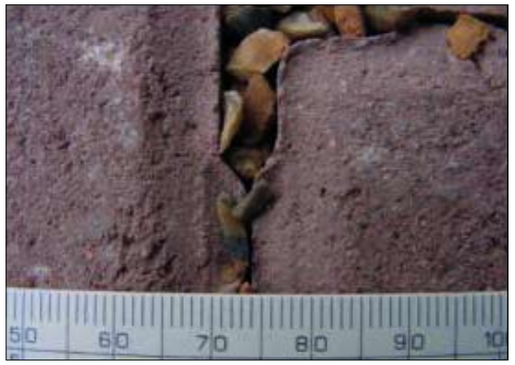


Fig. 2 When the joints between the Priora pavers are fully filled the particles become firmly wedged and enhance interlock.

SUB BASE MATERIALS

Open graded materials are required to allow storage of the surface water within the pavement construction. Therefore, for each site two sub-base designs are carried out, a structural design and a hydraulic design. Of the two sub-base thicknesses designed, the greater one, therefore meeting the requirements of both considerations, will be used for the final pavement design.

The Open Graded Crushed Rock (OGCR) or Open Graded Crushed Gravel (OGCG) sub-base should have a porosity of at least 0.32 to allow void space for water storage. The structural strength of the materials should be adequate for the loads to which it will be subjected. The OGCR or OGCG sub-base should be in accordance with BS EN13242: 2002. 'Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction'.

Due to the relationship between the grading curve of the OGCR or OGCG sub-base material and the laying course material, a geotextile between these layers may not necessarily be required.

The material should meet the following grading:

SUB - BASE GRADING	
RECOMMENDED BS EN 13242 AGGREGATE mm	10/20
RECOMMENDED BS EN 13242 GRADING/TOLERANCE CATEGORY	Gc80/20
SIEVE SIZE (mm)	PERCENTAGE BY MASS PASSING ISO 565 SIEVE
31.5	98 to 100
20	80 to 99
14	20 to 70 (±15)
10	0 to 20
6.3	
4	0 to 5
2	
3.15	
2.8	

PRIORA PERMEABLE PAVING

MANUFACTURING STANDARDS

During the life of this Design Guide, most current British Standards are being superseded by European Standards. In the transition period (typically 12 months), manufacturers can supply to either the existing British or new European standards. Due to the different stages of all the standards involved, it is difficult to state the exact standard to which a product is currently being supplied. Where appropriate, Marshalls always manufactures products that exceed or comply to all relevant standards, and will manufacture products that will exceed or comply to new European Standards once they are introduced to the UK.

Reference should be made to our product data sheets, available via Marshalls web site, or to our technical advisory service to determine to which standard a particular product is currently being manufactured and supplied.

QUALITY POLICY

Marshalls aims to produce and supply to all clients excellent building materials for all applications. It is the intention to achieve this by offering:

- Products that meet all standard requirements
- First class customer service
- Complete and on-time deliveries
- Free technical advice

Marshalls is committed to continual review and improvement of processes, products and services and places its customers first in considerations. These aims will be achieved by continual training and communication to all personnel of key business objectives.

Objectives are set at Group level and instigated by Divisional and Regional management within annual business plans.

ENVIRONMENTAL POLICY

Marshalls is committed to achieving the highest standards of environmental performance and continually aims to prevent pollution and minimise the impact of its operations. The Group's aim is that no lasting environmental damage occurs as a result of its activities, and policies are being implemented to ensure that all of its operations meet or exceed the requirements of legislation and applicable best practice.

Marshalls regards compliance with relevant environmental laws, and the adoption of responsible standards where no legislation exists, as an integral part of its business strategy and is committed to considering the environmental impacts associated with its products throughout their life-cycle.

Marshalls has committed to monitor its environmental performance in line with Construction Products Association requirements, and to set objectives and targets to improve its impacts in key areas. These will be reviewed on at least an annual basis to ensure continual improvement.

Marshalls will continue to raise environmental awareness within the Group through the development and training of its employees and will communicate openly and consult with customers, suppliers and other stakeholders on relevant environmental matters.

Marshalls strives to conserve natural habitats and create additional areas of wildlife value wherever possible. The Group also recognises the need for sympathetic restoration and afteruse of quarry sites and considers the character of the local environment and the concerns of the community when planning such matters.

TECHNICAL ADVISORY SERVICES

Fully committed to promoting good practice in the design and use of landscape and building materials, Marshalls offer unrivalled technical support.

Specifiers and contractors can draw on our wealth of experience and expertise. The Marshalls Technical Advisory Team offers design advice, technical support and on-site involvement throughout a project's entire development.

Technical Hotline

For all enquires of a technical nature such as installation, design advice, maintenance and health and safety issues.

Direct Line: 08704 113344 (choosing option 4)

e-mail: advisory.services@marshalls.co.uk

Commercial Enquires

For enquires regarding pricing, availability and orders.
Sales Office: 0845 302 0600
www.marshalls.co.uk/paving

Contact Address

Marshalls, Landscape House, Premier Way, Lowfields Business Park, Elland, West Yorkshire HX5 9HT

TEL: 01422 312000
www.marshalls.co.uk/drainage

FURTHER INFORMATION

PRIORA PERMEABLE PAVING