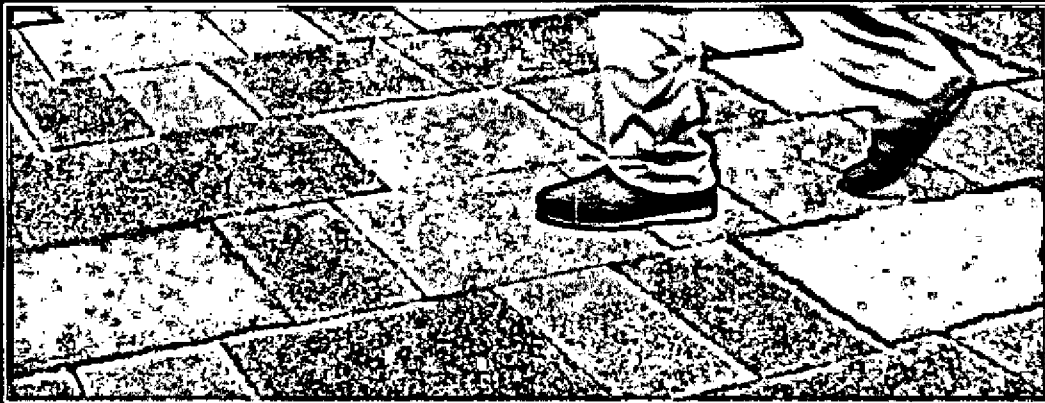




Marshalls

Creating Better Spaces



Walberton Place Care Home

PREPARED FOR: MAUGHAN REYNOLDS PARTNERSHIP

PROJECT NUMBER: 5607721

DESIGN NUMBER: DR008489

DATE: 16/08/18

Marshalls Water Management: Piora Permeable Paving
Design

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DESIGN NOTES

Marshalls Permeable Sub-base Design Standard(s) used:

- Methodology developed by Professor John Knapton of Newcastle University for Marshalls
 - Figures have been calculated using XP solutions Microdrainage software which applies the Wallingford Procedure or Modified Rational Method and uses FSR rainfall data.
 - CIRIA C753: The SuDS Manual
 - Interpave: SuDS + Permeable Paving Today
 - Further References:
 - BS 7533 part 13
 - Environment Agency SuDS: www.environment-agency.gov.uk
 - Sewers for Adoption – 7th Edition
 - Sewers for Scotland – 3rd Edition
-

- All advice given assumes the use of Marshalls product in your project specification. If you use any other manufacturer's products, Marshalls can accept no responsibility whatsoever for the performance of those products, or generally for the advice we have given.
- Where no falls or levels have been specified, Marshalls have assumed these areas as flat.
- Areas are only estimates and are provided in good faith, but must be checked by the customer prior to ordering. No responsibility can be accepted for shortfall or excess of materials.
- As Marshalls are not involved in the overall design, management and supervision of the project, or the selection of materials or contractors, we cannot be liable for the performance of our products on site and in use. This does not detract from the customers rights under common law for claims made against the quality of our products, should the situation arise.
- As the scheme's designer retains overall control of the project, it must remain their responsibility to check our proposals ensuring that all design and statutory requirements are met. Marshalls are not able to accept any responsibility for failure to check our proposals.

DESIGN PARAMETERS

When determining the depth of a permeable sub-base, two aspects of the design are considered. These are the structural design, based on the loading and ground strength, and the hydraulic design, based on the storm type and sub-base capacity. The structural design has been calculated using the design methodology developed by Professor John Knapton of Newcastle University for Marshalls. The hydraulic design of the pavement has been calculated using MicroDrainage. Both of these designs will provide a depth for the permeable sub-base, with the greater of the two dictating the final design.

Marshalls Permeable Sub-base Design Proposal is based on the following parameters:-

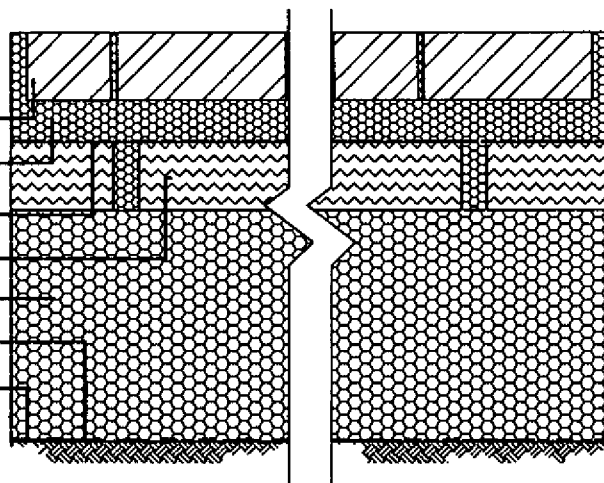
- Information provided by Jeff Southern of Maughan Reynolds on 03/08/2018.
- We have referred to drawings 401 & 402 Proposed drainage and external works layout in the preparation of this proposal.
- Hydraulic depth factors:
 - storm return period: 30+40% as requested
 - ground infiltration rate: 1.67×10^{-5} m/s
 - factor of safety: 1.5
 - $M5-60 = 19.4$ and $R = 0.336$
- Structural depth factors:
 - CBR value: 1-5+%
 - Traffic loading conditions: 1 HGV per week
- Areas Considered
 - Total catchment area: 1164 m²
 - Permeable Pavement area: 1164 m²

DESIGN RESULTS

Pavement design

After evaluating the structural and hydraulic designs it is evident that the hydraulic design is dictating the depth of construction. The following design will be suitable both hydraulically and structurally based on the above parameters.

	CBR Subgrade				
	1%	2%	3%	4%	5%+
Priora Blocks	80	80	80	80	80
Laying Course	50	50	50	50	50
MT120 Filtration Textile	-	-	-	-	-
DBM 40/60 Pen	70	70	70	70	70
Sub-base (OGCR)	325	275	250	250	250
MG15 Geogrid	-	-	-	n/a	n/a
MT120 Filtration Textile	-	-	-	-	-
Total Construction Depth (mm)	575	525	475	450	450



Quantities

Quantities presented for 2% CBR.

- 4-20mm Graded OGCR/Stone: 577 tonnes
- 2-6.3mm Graded OGCR/Stone: 115 tonnes
- MG15 Geogrid: 7 rolls
- MT120 Filtration Textile: 6 rolls

Additional Design Information

*Drawing DR008489 shows the permeable paving layout and the construction details. The roadbase is to be DBM 50 pen to SHW clause 929 laid to SHW clause 903 with 75mm diam. at 750mm centres filled with laying course material. Other material specifications are listed below.

MATERIAL SPECIFICATION

MM380 Tanking Membrane



An impermeable tanking membrane that has been developed exclusively for use within Type C (non-infiltration) Priora permeable pavements. While thinner and lighter than most commonly used alternatives, M380 demonstrates superior strength and puncture resistance, which ensures that angular Priora aggregate will not compromise the integrity of your water tight system

Technical Specification:

Characteristic	Value or Statement	Units	Compliance Criteria	Test Method
Length	20	m	-0% / +10%	EN 1848-2
Width	4	m	+/- 2.5%	EN 1848-2
Thickness	0.38	mm	+/- 10%	EN 1849-2
Mass	395	g/m ²	+/- 12%	EN 1849-2
Resistance to Impact	30	mm/diameter	>MLV	EN 12691
Resistance to tearing	185 185	N	MDV	EN 12310-1
Tensile strength	24.2 20.7	N/50mm	MDV	EN 12311-1

	Dimensions	Item Code
MM380 Tanking Membrane (roll)	20m x 4m (80m ²)	DYPV9701000
Top Hat including Clip	110mm	DYPV9701100
Top Hat including Clip	160mm	DYPV9701200
Jointing Tape (roll)	15m x 100mm	DYPV9701300

MT120 Filtration Membrane



Marshall's unique grade of Geotextile material can be included in Priora sub-bases to maximise water cleansing performance. Supplied in practical parking-bay sized rolls, MT120 is easy to roll out and cut allowing for fast installation.

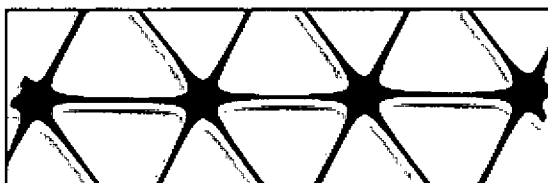
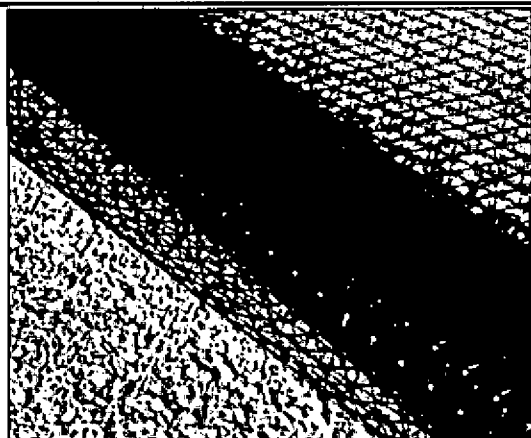
Technical Specification:

Characteristic	Value	Units	Test Method
Length	100	m	For Guidance
Width	5.4	m	For Guidance
Roll Weight	65	kg	For Guidance
Thickness	1.0	mm	BS EN ISO 12956
Static Puncture Strength (CBR)	1800	N	BS EN ISO 12236
Tensile Elongation	45	%	BS EN ISO 10319
Mass per unit area	120	GSM	BS EN ISO 9864
Water flow	120	l/sm ²	BS EN ISO 11058
Air Permeability	719	l/sm ²	ISO 9237:1995

MT120 Filtration Textile is available ex-stock

	Dimensions	Item Code
MT120 Textile	5.4m x 100m (540m ²)	PV9702500

MG15 Geogrid



A special grade of GeoGrid that has been developed with eh UK's market leading grid supplier to provide additional stability within the sub-grade, the voids in MG15 Grid are the ideal size and shape to interlock with Piora aggregate, confining movement and improving the CBR of the ground by 1%-which can, in some conditions, reduce the depth of the sub-base, saving time and money.

Technical Specification:

Property	Value
Rib Shape	Rectangular
Aperture Shape	Triangular
Open Area Aspect Ratio	>85%
Junction Efficiency	>90%
Resistance of Chemical Degradation	96%
Resistance to Weathering	98%
Resistance to Oxidisation	90%

Dimensions	Item Code
MG15 Grid (roll)	50m x 4m (200m ²)
	PV9701400

Marshall's MG15 Grid is available ex-stock

Aggregates



In a Priora permeable system, what's underneath the surface is as important as the blocks themselves, Marshalls nationally sourced, carefully specified grade of aggregate has been selected because of its superior void ratio and maximum internal angle of friction – which ensures that your permeable pavement will perform both structurally and hydraulically. Sourced from quarries all over the UK to minimise the carbon footprint of your job. To order, please contact Priora Aggregate Sales Line 0845 451 0797 or Technical Advisory service on 08704 112233, who will put you in touch with your nearest recommended supplier.

Technical Specification:

The laying course material provides a flatter platform onto which the blocks are laid, to prevent any rocking or instability of the blocks in-situ. The same material should also be used as the jointing material for the system.

Sub-base Grading Requirements

Recommended BS

EN 12620

4/20

Aggregate (mm)

Recommended BS

EN 12620

Gc80/20

grading/tolerance

GTc 20/15

category

Grading Details

Sieve size (mm)	Percentage by mass passing ISO 565 sieve
31.5	98 to 100
20	90 to 99
14	
10	25 to 70
6.3	
4	0 to 15
3.15	
2	0 to 5

Laying Course Grading Requirements

Recommended BS

EN 12620

2/6.3

Aggregate (mm)

Recommended BS

EN 12620

Gc80/20

grading/tolerance

GTc 20/15

category

Grading Details

Sieve size (mm)	Percentage by mass passing ISO 565 sieve
31.5	
20	
14	100
10	98 to 100
6.3	80 to 99
4	
2	0 to 20
1	0 to 5
0.063	0 to 2

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 EN12620. 'Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction'.

Properties

Category to BS EN 13242 or BS 12620

Grading	4/20 (preferred) or 4/40, GC 85-15, GTc 20/17.5
Fines Content	f4
Shape	Fl ₂₀
Resistance to Fragmentation	LA ₃₀
Internal Angle of Friction	40°
Durability: Water Absorption to BS EN 1097-6:2000+A1:2005, Clause 7 for WA>2% -	WA ₂₄₂
Magnesium sulphate soundness	MS ₁₈
Resistance to wear	MS _{DE20}
Acid Soluble sulphate content: - aggregates other than air cooled blast furnace slag	AS _{0.2}
-air cooled blast furnace slag	AS _{0.1}
Total Sulphur: - aggregates other than air cooled blast furnace slag and	<1% by mass
-air cooled blast furnace slag	<2% by mass
Volume stability of blast furnace and steel slags: air cooled blast furnace slag	Free from dicalcium silicate and iron disintegration in accordance with BS EN 13242:2002+A1:2007, 6.4.2.2. Vs
-steel slag	Blast furnace slag and other recycled materials should meet the requirements of the environment agency "waste acceptance Criteria" A) for inert waste when tested in accordance with BS EN 12457-3
Leaching of contaminants	

A) Guidance on waste acceptance criteria for inert waste is given in the environment agency's guidance for waste destined for disposal in landfills.

CONTACT DETAILS

Should you have any queries or require any clarification regarding any aspect of this document or require on-site technical support and advice please do not hesitate to contact the following:

Design Team

Contact Marshalls Design Team for a rapid response to technical queries, CAD requests and product advice

Design Team -

Benjamin Birkhead:
e-mail:

Regional Pavement Engineer

Maeve Cullen
e-mail:

Sales Consultant

Richard Sample
e-mail:
Sales Office:

For further information on products please visit our website:

Marshall's Design Warranty



"Marshall's" means Marshall's Mono Limited, its direct and indirect holding companies and any subsidiary of it or of such holding companies.

1. Copyright in our designs

- 1.1 This Design has been produced specifically for the site stated in the design. All design advice is specific to your Project. The finished Design together with all drawings, plans, specifications and other preparatory material and advice produced by or on behalf of Marshall's is subject to the law of copyright and Marshall's asserts its exclusive copyright in such material and retains all copyright and other intellectual property rights in such materials. This Design and/or design advice may not be copied or used for other projects without the express prior written approval of Marshall's.
- 1.2 For these purposes "Design" means the design attached to these conditions, any design included in the specification and/or any other design or technical advice provided by Marshall's in writing in connection with the Project, including any revisions, amendments and updates made by Marshall's to these designs and/or design advice, and "Project" means the customer's specified project (where "customer" includes any contractor, architect, specifier or agent who is identified as the customer) in connection with which the Design is supplied.

2. Exclusion of Liability

- 2.1 This Design and any advice provided to you by Marshall's in connection with this design are specific to your Project. You acknowledge that in preparing the Design and providing the advice we have relied upon information supplied by you and/or your professional advisers, agents and/or contractors relating to the Project site and we take no responsibility for any failure or defect arising directly or indirectly from incomplete, inaccurate or misleading information provided to us, or arising as a consequence of any act, omission or failure by you or any third party contractor, engineer, quantity surveyor, architect or other professional adviser engaged in relation to the Project.
- 2.2 This Design and any advice provided by Marshall's have been prepared and delivered on the basis that Marshall's products are explicitly specified and will be used. If you use any other manufacturer's products, Marshall's can accept no responsibility whatsoever for the performance of those products, nor can we give any assurance that this Design and/or advice provided by Marshall's will be suitable for use with those products.
- 2.3 As Marshall's is not involved in the overall management and supervision or the selection of materials or contractors on site we will not be liable for any failure in our products caused by the actions or omissions of third parties or the treatment of our products on site and in use. This does not affect your statutory rights.
- 2.4 Marshall's will have no liability for loss of profit, loss of use, loss of contract and/or any indirect or consequential loss or for any liquidated damages that may arise in respect of the Project. Our total liability to you arising in connection with the Project in any event will not exceed the lower of the aggregated value of materials supplied by Marshall's to the Project or £500,000.
- 2.5 To the extent permitted by law, the warranties and remedies set out in this document relating to the Design and any advice provided by Marshall's in relation to the Project are exclusive and in lieu of all warranties and remedies and contract terms, express or implied by law, including any contract terms implied by law as to quality or fitness for any particular purpose provided that this clause does not exclude liability for death, personal injury or fraudulent misrepresentation to the extent such exclusion would be prohibited by law.

3. Design warranty

- 3.1 In providing this Design and any written advice in relation to the Project Marshall's has used the standard of skill and care which would reasonably be expected from an experienced manufacturer of paving and drainage products of the type supplied by Marshall's to the Project.
- 3.2 To maintain best practice and in keeping with the BS EN ISO 9001 quality management system, Marshall's has its own internal checking procedure in place which involves a design verification process for work carried out by members of Marshall's Design Warranty engineering teams. It is essential that the qualified individual appointed by the customer agrees with the design data inputs and outputs particular to their Project before installation, as project requirements can change during the lifespan of the Project prior to commencement of the installation stage.
- 3.3 Marshall's warrants that it will repair or replace or provide a refund (at Marshall's discretion) in respect of any failure of the Design or of any Marshall's product installed in accordance with the Design to conform to the stated standard within 10 years of installation up to a total aggregated cost of £50,000, provided that:

v2 April 2015

Marshalls Design Warranty



- 3.3.1 Marshalls' specification and guidance (as provided by Marshalls in writing) has been followed diligently including our recommendation for all component materials that form part of the Design.
- 3.3.2 Only Marshalls paving products have been used.
- 3.3.3 The relevant Design has been checked and signed off prior to the installation stage by a qualified individual associated with the Project acting on behalf of the customer, such as a project/design manager.
- 3.3.4 The finished Project incorporating the products in the Design must have been installed and maintained at all times in accordance with Marshalls' guidance.
- 3.3.5 Any claims are submitted to Marshalls in writing within 10 years of the Project having completed (or such part of the Project that includes the Design) and in any event within 2 calendar months of the date on which the claimant became aware or should have become aware of the event or circumstance giving rise to the claim.

If any of the above conditions (3.3.1) to (3.3.5) inclusive have not been met, the above warranty will be invalid and Marshalls shall have no liability in respect of the Design and/or the products installed in accordance with the Design.

- 3.4. The above warranty will cover the performance of a sub-base incorporated into the Design. It expressly excludes any liability of Marshalls in respect of workmanship in relation to the sub-base and/or any installation whatsoever, including installation of any Product and/or the sub-base, and/or any defects or damage which occurs as a result of ground conditions (including but not limited to hydrological, climatic natural and/or physical conditions and man-made and other physical obstructions and pollutants).
- 3.5. The above warranty is for the exclusive benefit of the customer and may not be assigned or otherwise transferred to any other party without the written consent of Marshalls in its absolute discretion.

4. Insurance

Marshalls carries public and products liability insurance to a level of at least £10m and professional indemnity insurance to a level of £5m in respect of its designs.

5. Terms and Conditions

These conditions are in addition to and do not exclude the standard terms and conditions of Marshalls applicable to the sale of products to the Project from time to time. To the extent that any provisions of these design terms conflict with Marshalls' standard terms and conditions of sale, these provisions shall prevail insofar as they apply to the Design and any advice in connection with the Design. These conditions will also prevail over any terms and conditions which any contractor, architect, specifier and/or other customer may seek to impose on Marshalls in relation to the Project.

These conditions will be governed by English law.