

HYDROSTON TECHNICAL NOTE NO. 1

HYDROSTON PERMEABLE PAVEMENTS - DRIVEWAYS

Technical Note No. 1 details the use of HydroSTON pavers in driveway applications, which allow infiltration directly into the ground.

DRIVEWAY STRUCTURE

A permeable driveway should have a structure comprising:

- HydroSTON 80 pavers 80 mm
- Joints and joint filling
- Bedding layer 30 - 40 mm
- Geotextile layer
- Base course 100 mm min

overlying a subgrade with sufficient permeability and strength to carry light vehicles (see illustration on page 4).

SUBGRADE

Subgrade strength is generally characterized in terms of Design California Bearing Ratio (CBR) value. Permeable pavements intended for vehicle traffic and infiltration should have a subgrade CBR ≥ 5 .

Sandy subgrades having a CBR of 12% or more have good permeability and are stable when saturated. Such soils are generally suitable as a driveway subgrade and for stormwater infiltration.

A *low-strength subgrade* is generally classified as one having a design CBR of 4% or less. Most clays have a CBR of 4% or lower. Low strength subgrades can present difficulties in achieving a firm and stable platform for base course construction in their unmodified form using conventional compaction methods. Where the pavement is to carry traffic, low strength subgrades require special attention during design.

Subgrades with low CBR values are generally unsuitable for infiltration but should not restrict the use of permeable pavement provided sub-surface drains are installed for removal of water and appropriate stabilisation measures are taken.

A geotechnical investigation is recommended where the subgrade is likely to be characterized as low strength.

HYDROSTON PAVERS

HydroSTON™ is the registered trade mark of HydroCon Australasia Pty Ltd, covering the full range of permeable concrete pavers manufactured by HydroCon in Australia.

HydroSTON permeable pavers are a new technology and there is currently no specifically applicable Australian Standard. HydroSTON pavers, however, are generally compliant with AS/NZS 4455.

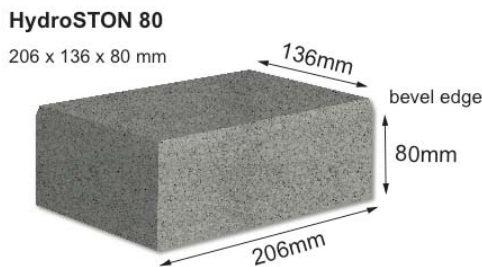


HydroSTON pavers have a face area of less than 0.10m² and are therefore categorized as segmental pavers under AS/NZS 4455. Paving units are manufactured with plain sides and plain top and bottom faces.

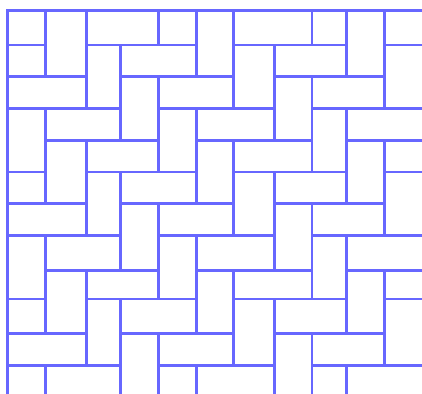
The pavers are rectangular in shape and are classified under CMAA T44 as Type C pavers – units which do not key together and which rely on their dimensional accuracy and accuracy of laying to develop interlock.

In new condition, HydroSTON pavers are able to drain at a rate of 4.5 l/s/m² (equivalent to 45,000 l/s/ha, 16,200 l/hr/m², 0.0045 m/s, 4.5 mm/s, 270 mm/min, 16,200 mm/hr).

HydroSTON 80 pavers should be used for driveway applications (see HydroSTON 80 specifications at page 5).



HydroSTON 80 pavers should be laid in standard herringbone pattern or variants such as 'elbow interlock'.



Since concrete pavers may exhibit minor variations in colour, it is recommended that pavers be selected from 3 pallets and from different levels of each pallet. This widely recommended procedure avoids concentrations of colour and gives a more harmonious appearance.

HydroSTON permeable pavements may be constructed on gradients up to at least 7.5% without adverse effect on paver performance.

EDGE RESTRAINTS

Edge restraints should be provided around the periphery of the driveway to the full depth of the pavement cover. Edge restraints should be capable of preventing the loss of bedding material and minimising the sideways movement of the pavers. Restraints must also be capable of accepting traffic loads.

JOINTS AND JOINT FILLING

Joint width should be 4mm average. Joint filling material should be clean single size crushed basalt or similar aggregate having a particle size of between 1-3mm. The material should contain a maximum fine content (particle size ≤ 75 µm) ≤ 3%. HydroCon supplies specially graded joint filler in 1 tonne bulk bags and 20 kg polyethylene bags.

Joints should be filled continuously during placement to prevent movement of pavers. Filling material should be spread over the pavement and the joints filled by brooming.

Care should be taken to ensure that joints between individual paving units, and between paving units and edge restraints, are fully filled and compacted with joint material to ensure interlocking of pavers.

BEDDING LAYER

Bedding material should be clean single size crushed basalt or similar aggregate having a particle size of between 2-5mm. The material should contain a maximum fine content (particle size $\leq 75\mu\text{m}$) $\leq 3\%$ according to AS1141.12.

A suitable 5mm single size aggregate will have a particle size distribution corresponding to the following grading limits:

AS Metric Sieve mm	% Passing
6.7	100
4.75	85 - 100
2.36	1 - 15
1.18	0 - 5

Aggregate should be spread in a single uniform layer over the base course and screeded in a loose condition to a depth necessary to achieve a uniformly thick layer after laying and compaction of the pavers of between 30-40mm. The appropriate depth of screeded material may be determined by laying a trial area before construction. 5mm single size basalt layer will generally reduce by 10mm after compaction of pavers.

Surfaces of the base course and bedding layer should be uniform with no irregularities in levels. The bedding layer should not be used to compensate for irregularities in the base course, since any unevenness in the bedding layer may cause deformation of the pavement during compaction, which could later increase under traffic load.

Any screeded bedding material left exposed should be checked for depressions and levels and, where necessary, rescreeded before further pavers are laid.

Bedding material should not be screeded more than two metres in advance of the laying face at the completion of work on any day.

GEOTEXTILE LAYER

Unwoven geotextile should be laid between the base course and the bedding layer to improve structural stability and prevent migration of bedding and base course materials. The geotextile should have a hydraulic conductivity $> 3,600\text{mm/hr}$. Suitable fabrics include Geotex 401 (*Synthetic Industries*) and Bidim (*Geofabrics*).

BASE COURSE

Base course material must have low fines and be free draining. Densely Graded Base materials eg DGB20, normally used for road pavements, or recycled products including slag, recycled concrete etc should not be used under any circumstances.

Base course material should consist of virgin, quarried crushed rock conforming to the specifications set out on page 6.

Material should be 5-20mm low fines Fine Crushed Rock (FCR), consisting of sound, hard, durable rock, free of organics, clay matter or other deleterious materials or coatings. The material should meet the following particle size distribution in accordance with AS1141.11 (washed grading).

AS Metric Sieve mm	% Passing
26.5	100
19.0	95 - 100
9.5	65 - 85
4.75	45 - 65
2.36	25 - 40
425 μm	10 - 20
75 μm	2 - 6

Test methods applicable for base materials are set out on page 6. Tests should be conducted by a NATA accredited laboratory.

Minimum base thickness for driveway applications should be 100mm but in some applications may need to be up to 250mm.

Material should be compacted in 100mm layers until stable. The topmost layer should be filled to approximately 50mm above the target height and compacted until stable. Depending on the compacted height achieved, further fill may be necessary or compacted fill removed. In both situations, material should be compacted within ± 10 mm. The level of the finished base course should be the combined thickness (mm) of the paver and bedding layer below the design surface of the pavement.

The base course should be compacted to not less than 98% of standard maximum dry density according to AS1289.5.1.1. Because of the low fines requirement, the base course will be harder to compact than normal road base course material.

COMPACTION OF PAVEMENT COVER

As soon as the driveway has been laid and joints filled, the pavement should be swept to remove excess filling material. Long driveways should be completed in sections.

The pavement should then be compacted to achieve consolidation of the bedding layer (approx. 10mm settlement). The surface should be brought to design levels and surface profiles by not less than two passes of a high frequency, low amplitude mechanical flat plate vibrator fitted with a rubber or plastic apron to protect the paved area.

Joints should be refilled after compaction to fully close gaps in the joints.

Paving operations should be arranged so that use of the plate compactor proceeds progressively behind the laying face without undue delay, and such that compaction is completed prior to cessation of construction activity on any day. Compaction should not be attempted within 1 metre of the laying face except on completion of the pavement against an edge restraint.

MAINTENANCE

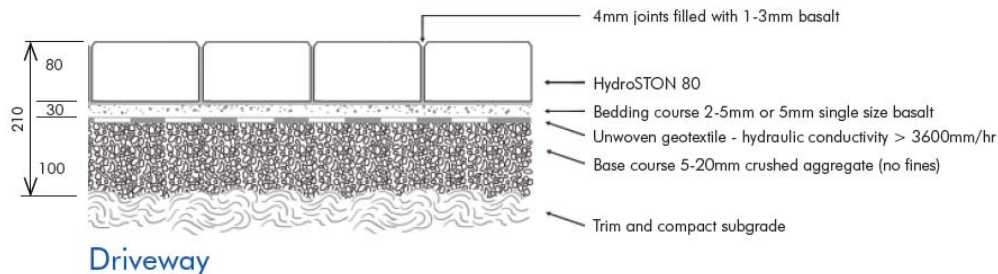
HydroSTON pavers used for driveways will require little maintenance.

Pavements should be swept from time to time to remove debris. This can be undertaken manually or mechanically (blower), depending on the size of the driveway.


Care should be taken during sweeping not to force debris into the top structure of the pavers.

Should any pavers become clogged over time due to heavy sediment loads, affected pavers can be removed, turned over and cleaned by high pressure hosing.

Joint filling should also be checked from time to time and topped up as necessary.



PRODUCT SPECIFICATIONS – HYDROSTON 80

		
Material		Porous concrete
Category	AS/NZS 4455	Segmental
Shape	CMAA T44	Type C
Void (pore) space	%	10
Drainage rate	mm/min	270
Work size	L x W x T mm	206 x 136 x 80
Dimensional deviation	AS/NZS 4455	DPA1
Face (gross plan) area	m ²	0.0280
Bevelled (chamfered) edges	mm	6
Joint width	mm	4
Design dimensions (with joints)	L x W x T mm	210 x 140 x 80
Design plan area ¹	m ²	0.0294
Units per m ²	no.	35.7
Breaking load – mean [standard deviation]	kN	17.0 [2.0]
Modulus of rupture – mean [standard deviation]	MPa	4.4 [0.5]
Recommended colours	colour chart	Natural or Charcoal
Dry weight per unit	kg	4.22
Units per pallet	no.	400
Pallet weight ²	tonnes	1.728
Coverage per pallet	m ²	11.2
Recommended laying pattern	type	Herringbone

1 From design plan dimensions (work size plus joints)

2 Includes 40kg wooden pallet

Test Methods - Aggregates

AS1141.3.1	Sampling
AS1141.5	Particle density & water absorption of fine aggregates
AS1141.6.1	Particle density & water absorption of coarse aggregates
AS1141.11	Particle distribution by sieving (washed)
AS1141.14	Particle shape by proportional calliper
AS1141.22	Wet dry strength variation
AS1141.24	Aggregate soundness (sodium sulphate solution)
AS1289.3.1.1	Determination of the liquid limit of a soil
AS1289.3.2.1	Determination of the plastic limit of a soil
AS1289.3.3.1	Calculation of the plasticity index
AS1289.5.1.1	Determination of dry density/moisture content – standard compaction

Coarse Aggregate (> 5 mm)

AS1141.6.1	Particle density > 2.5 t/m ³ ; water absorption < 2.5%
AS1141.14	< 25% on 2:1 calliper ratio
AS1141.22	Wet strength > 150kN; variation <35%
AS1141.24	Total weighted percentage loss < 5%

Fine Aggregate (≤ 5 mm)

AS1141.5	Particle density > 2.5 t/m ³ ; water absorption < 3.0%
AS1141.24	Total weighted percentage loss < 5%
AS1289.3.3.1	Non plastic

REFERENCE DOCUMENTS

<i>HydroCon Australasia Pty Ltd</i>	HydroSTON Permeable Pavement Manual
<i>Australian Standards</i>	AS/NZS 4455 Masonry units and segmental pavers
<i>Concrete Masonry Association of Australia</i>	T44 Concrete Segmental Pavements – Guide to Specifying
<i>Klostermann GmbH & Co. KG, Coesfeld & NatürlichSTEIN, Germany</i>	Pavement Planning Handbook 2006

RECOMMENDED SUPPLIERS

Aggregates	Hanson Construction Materials Daryl Rajnovic Quarry Sales Manager T: 02 9354 2678 M: 0408 227 240
Geotextiles	Geotextiles Supplies & Engineering Pty Ltd T: 02 9601 8077