May 2022

Permcon

Australia & New Zealand

Permcon:

continuous pour permeable concrete paving system

Firth

Proudly supplied by Firth Concrete Industries

Table of contents

Overview

What is permeable concrete?

Permeable or pervious concrete, which can also be referred to as porous concrete is specialist concrete with a high porosity. This product allows water to pass directly through it reducing the runoff and facilitating ground water recharge.

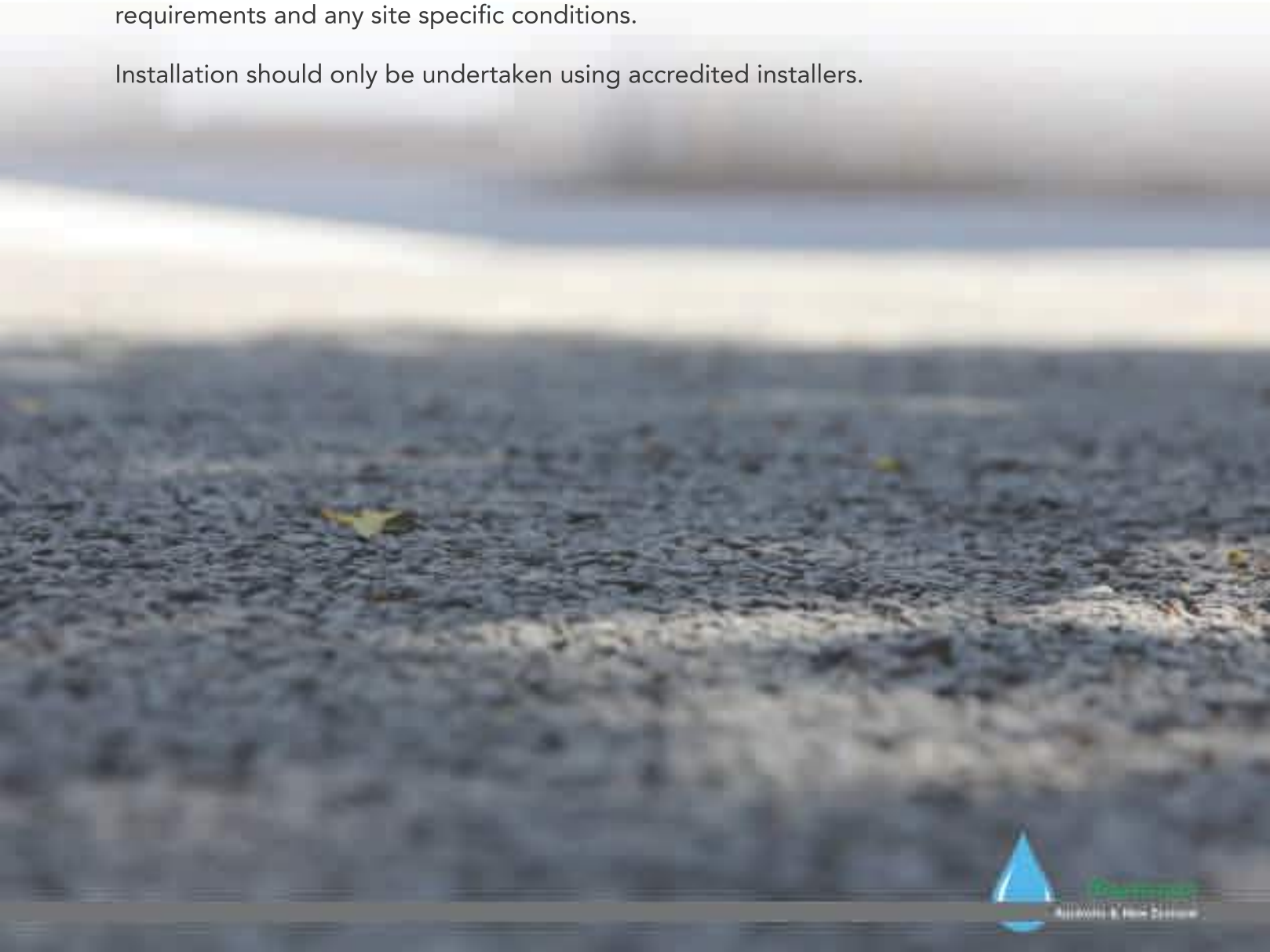
Types of porous “systems” include porous asphalt, pervious cement, permeable concrete, concrete paving-blocks, gravel paving systems, and grass paving systems, among others.

Permcon continuous pour permeable concrete reduces the run-off from paved areas due principally to the void content within the product, usually in the range of 20-25%. This feature enables the filtration of natural rainwater and stormwater through the product reducing the need for separate stormwater retention pits and rain gardens. In addition Permcon naturally filters stormwater and can reduce pollutents from entering into rivers, streams and ponds.

It also has the added benefit of being beneficial to the environment as it provides for the transfer of air and water to tree root systems to allow trees to continue to flourish even in highly developed urban areas.

This guide is for the installation of Permcon New Zealand's permeable concrete system , this guide should be used in consultation with an Engineer , Architect or Landscape Architect in order to ensure compliance with local council or regulatory authorities requirements and any site specific conditions.

Installation should only be undertaken using accredited installers.



Permeable Concrete Benefits

Reduces rain fall run off
decreasing demand on existing stormwater systems

Recharges natural ground aquafers
as per natural filtration in the pre developed environment

Reduces stormwater peak flows
by detaining the storm water and releasing in a controlled manner

Filters stormwater
by removing up to 70% of heavy metals, hydrocarbons, detritus and suspended solids

Reduces the size of retention structures
and maximises land use by retaining water within the system

Reduces the stormwater run off temperature
mitigating damage to receiving streams, rivers and waterways

Maximises land use
in a passive system , the permeable surfaces are considered as “grass” for design purposes

Terminology

Wearing Course - the Permcon permeable concrete layer, the thickness of which will depend upopmn application required.

Permeable Upon Basecourse - Normally WPB12 or similar, an open graded aggregate that provides a structural layer for to support the Wearing Course but also provides a storage medium for the detained stormwater.

Extended Permeable Basecourse - Normally WPB40 or similar, alarger grading of open graded basecourse included where larger volumes of stormwater need to be managed.

Sub Baser - sometimes referred to as a gravel raft, normally GAP40 or GAP65 used to create a stable platform to sit the Permcon System on, in low CBR situations.

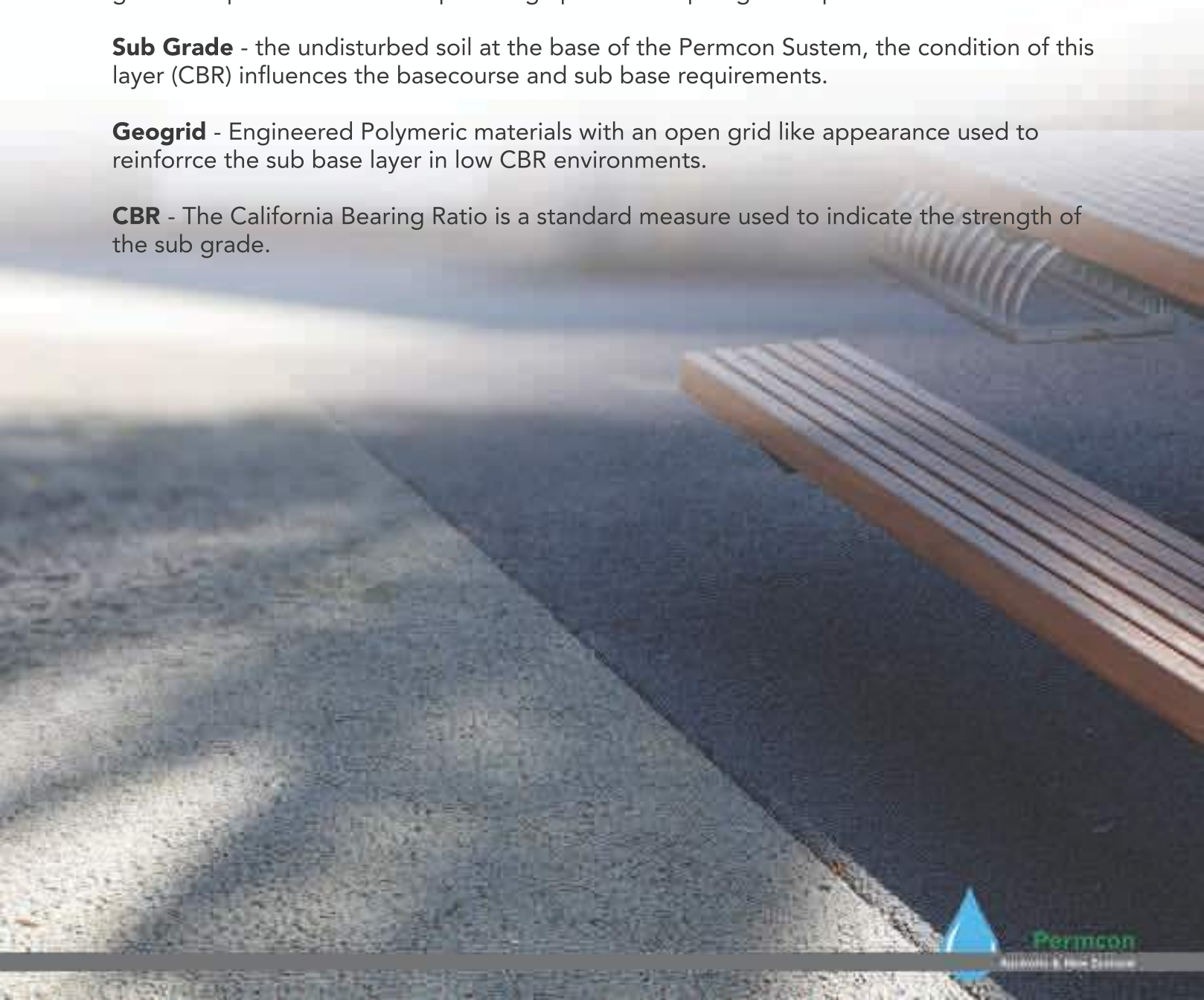
Sub Surface Drain - Normally a 110mm Novaflo pipe or similar, a drainage system which can be designed to drain excess stormwater in a controlled fashion into the local stormwater network reducing peak flows.

Filter Cloth - a non woven geotextile which allows water to pass through into the sub grade but prevents soils from punching up into the open graded permeable basecourse.

Sub Grade - the undisturbed soil at the base of the Permcon Sustem, the condition of this layer (CBR) influences the basecourse and sub base requirements.

Geogrid - Engineered Polymeric materials with an open grid like appearance used to reinforrce the sub base layer in low CBR environments.

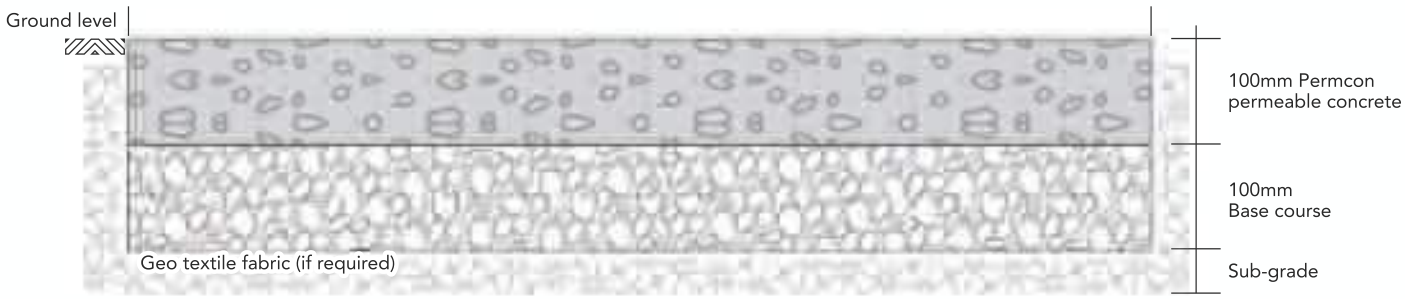
CBR - The California Bearing Ratio is a standard measure used to indicate the strength of the sub grade.



Applications

Common applications for Permcon are footpaths, domestic driveways, car parks, private open spaces, tree protection zones and balconies & patios.

Footpath (Typical Design)

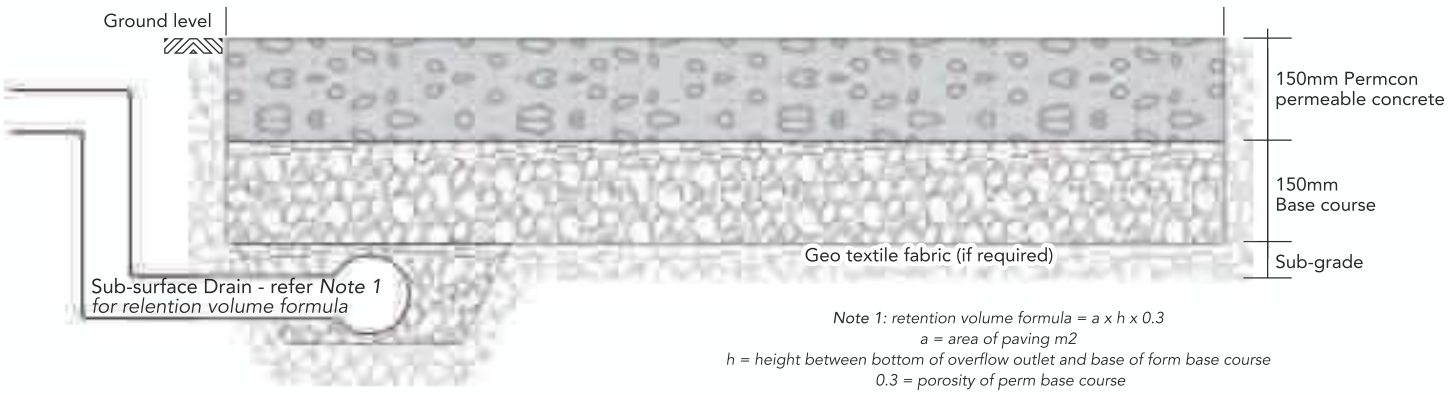


Surface/Wearing Course – The top surface or wearing course of the footpath is a layer of Permcon permeable concrete at a thickness of 100mm.

Base Course – The base course, or structural drainage layer directly below the wearing course should consist of a washed drainage aggregate. This layer acts as an additional storage layer and acts as additional temporary storage or retention tank prior to natural filtration into the sub-grade or stormwater infrastructure.

Filter cloth – Normally a non-woven geotextile which is a polypropylene fabric which allows water to pass through it and prevents the bedding sand from migrating into the sub-base drainage aggregates. Also assists in stopping contamination of the sub base drainage aggregates when surrounded by clay soil.

Driveway (Typical Design)



Note 1: retention volume formula = a x h x 0.3
a = area of paving m2
h = height between bottom of overflow outlet and base of form base course
0.3 = porosity of perm base course

Surface/Wearing Course – The surface or wearing course of the driveway consists of 150mm permeable concrete.

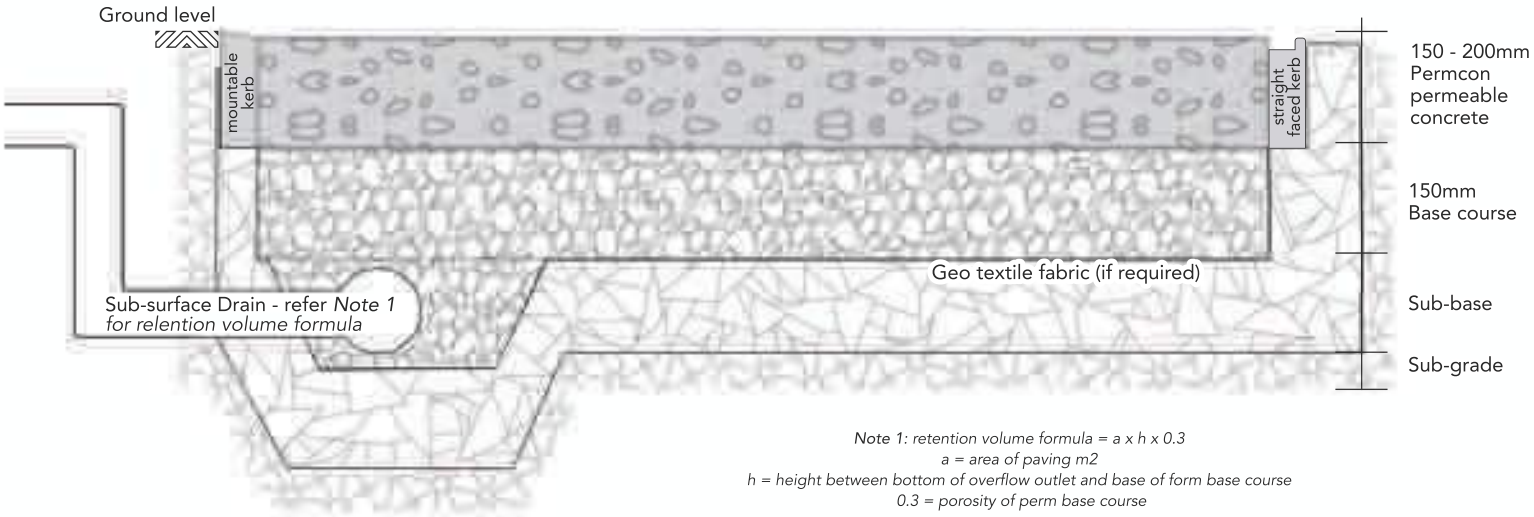
Base Course – The structural drainage layer supporting the driveway surface will consist of a 150mm layer of drainage aggregate. The aggregate used in the permeable base is a WP12 or similar open graded material. This layer will create a stable base in low CBR (California Bearing Ratio).

Sub-surface drain – A drainage system which allows water to enter it so it can be directed out
of the base course. Assists with removing water
in impermeable clay sub-grades and can be designed to reduce the stormwater peak flow.

Filter cloth – The filter cloth is a non-woven geotextile fabric designed to be used in situations where the soil is highly reactive. Whilst it facilitates the flow of water through it, it provides a barrier for contaminants to pass into the sub-base drainage aggregates.

Roadway (Typical Design)

May 2022



Note: It is essential in the design of a high-volume traffic area or roadway that the design be undertaken in consultation with a qualified civil engineer with emphasis placed on the likely moisture sensitivity of the sub-grade and the need for filter fabrics.

Surface/Wearing course – The roadway surface is typically poured at a thickness of 150-200mm of permeable concrete.

Base course – The base course will require a layering of aggregate and crushed rock with the size of the aggregate increasing based on the depth of this layer. Normal gap types of aggregate are not suitable as base course material.

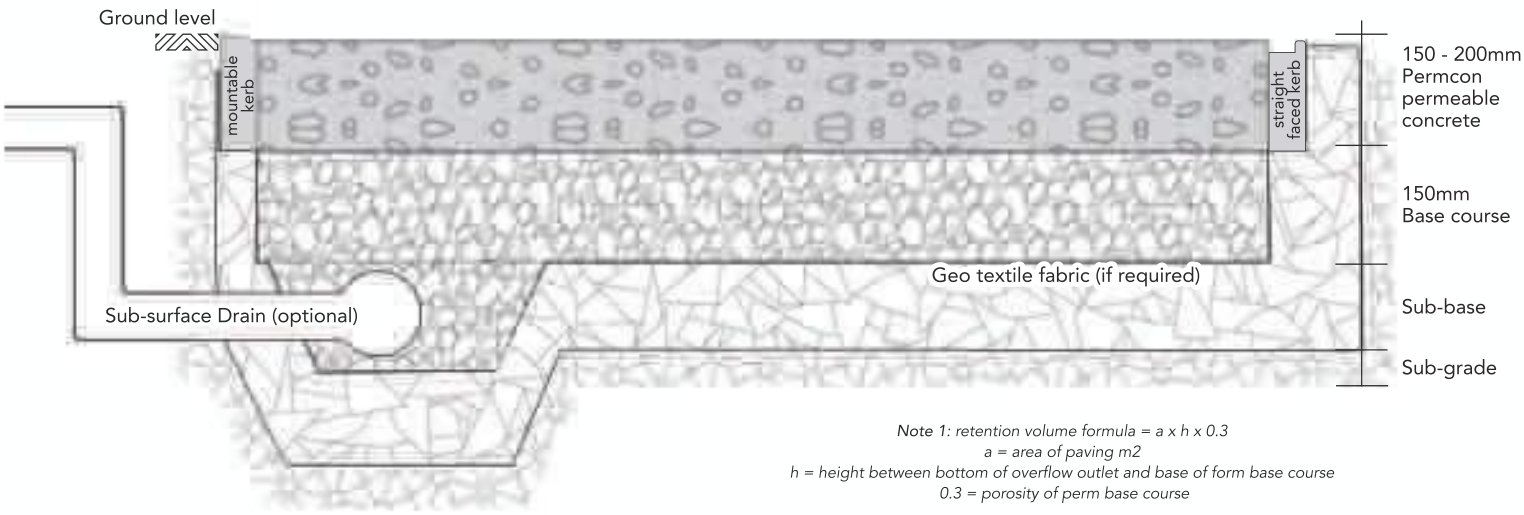
Sub-grade – The undisturbed soil at the bottom of the Permcon system. The strength of this influences the thickness of structural support layer of the base course.

Sub-surface drain – A drainage system which allows water to enter it so it can be directed out of the base course. Assists with removing water in impermeable clay sub-grades and can be designed to reduce the stormwater peak flow.

Filter cloth – Normally a non-woven geotextile which is a polypropylene fabric which allows water to pass through it and prevents the bedding sand from migrating into the sub-base drainage aggregates. Also assists in stopping contamination of the sub base drainage aggregates when surrounded by clay soil.

Carpark (Typical Design)

May 2022



Note 1: retention volume formula = a x h x 0.3
a = area of paving m2
h = height between bottom of overflow outlet and base of form base course
0.3 = porosity of perm base course

Surface/Wearing Course – The surface or wearing course of the carpark should consist of 150-200mm thickness of Permcon – permeable concrete. The determination of actual thickness of this layer should be done in consultation with a civil engineer and follow engineer designed civil/drainage specifications

Base course – The structural drainage layer directly under the permcon top surface should be a suitable drainage aggregate. This layer is also referred to as "storage medium" as it can act as a storage tank once the storm water run off has dissipated into it.

Sub-grade – The undisturbed soil at the bottom of the Permcon system. The strength of this influences the thickness of structural support layer of the base course.

Sub-surface drain – A drainage system which allows water to enter it so it can be directed out of the base course. Assists with removing water in impermeable clay sub-grades and can be designed to reduce the stormwater peak flow.

Filter cloth – Normally a non-woven geotextile which is a polypropylene fabric which allows water to pass through it and prevents the bedding sand from migrating into the sub-base drainage aggregates.

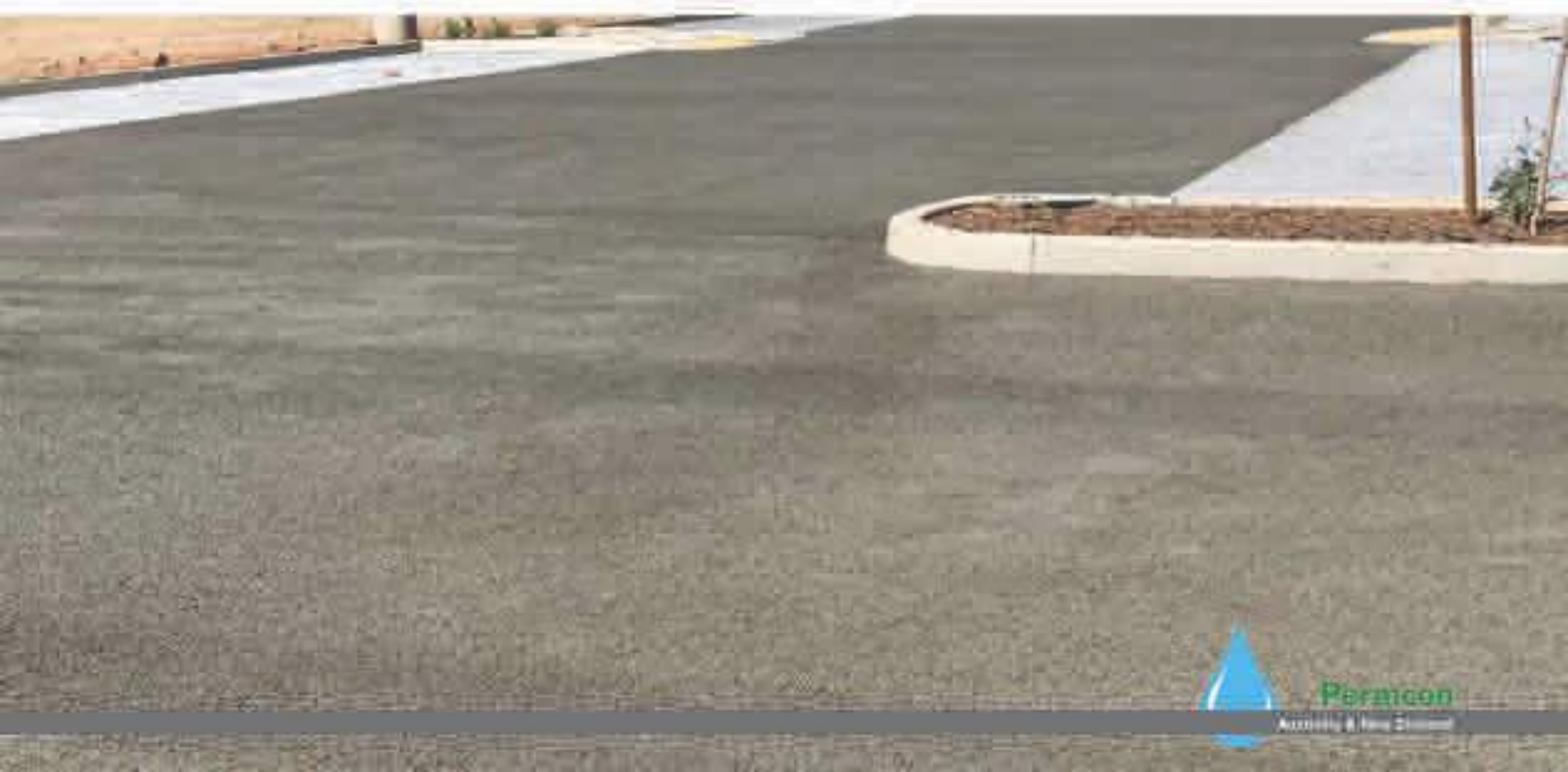


Table 1 - Application, Unit Type choice and indicative base course thickness

LOADING CONDITION	SUB GRADE CLASSIFICATION (SOAKED)		
	WEAK CBR 5	MEDIUM CBR 10	STRONG CBR 15
Residential Pedestrian Patio / Pathway	100mm	100mm	100mm
Geotextile Filter Cloth	Class C	Class B	Class A
Residential Light Traffic Single Unit Residential Driveways	150mm (maximum)	125mm	100mm
Geotextile Filter Cloth	Class D	Class C	Class B
Residential Light to Medium Traffic Multi Unit Residential Driveways	Specific Design	150mm (maximum)	125mm
Geotextile Filter Cloth		Class D	Class C
Public Footpath Low and High Impact	100mm	100mm	100mm
Geotextile Filter Cloth	Class D	Class C	Class B

CBR - California Bearing Ratio
On site assessment the following steps can be used for an on site Sub Grade assessment , this does not replace the need for a proper Geo Tech report it just provides a guide.

Once the Sub Grade is exposed, wet the ground and then walk across the Sub Grade.

– Walking leaves a strong / complete imprint, this indicates a weak CBR and is generally a clayey / silty soil type.

– Walking leaves a heel imprint only, this indicates a medium CBR and is generally a silty or clayey sand soil type.

Installation Surrounding/ Covering Tree Protection Zones (TPZ) (Typical Design)

Permcon is, in some circumstances, suitable for installation immediately adjacent to trees and tree root zones.

Permcon installed properly will contribute significantly to the long-term sustainability of the tree. Any installation that will cover a tree root zone should be designed in conjunction with an engineer.

Please note the following specific requirements:

1. The tree protection zone should not be excavated [ie. the roots should be preserved].

Note: this pertains only to installations surrounding trees and designed to specifically preserve the tree root zone.

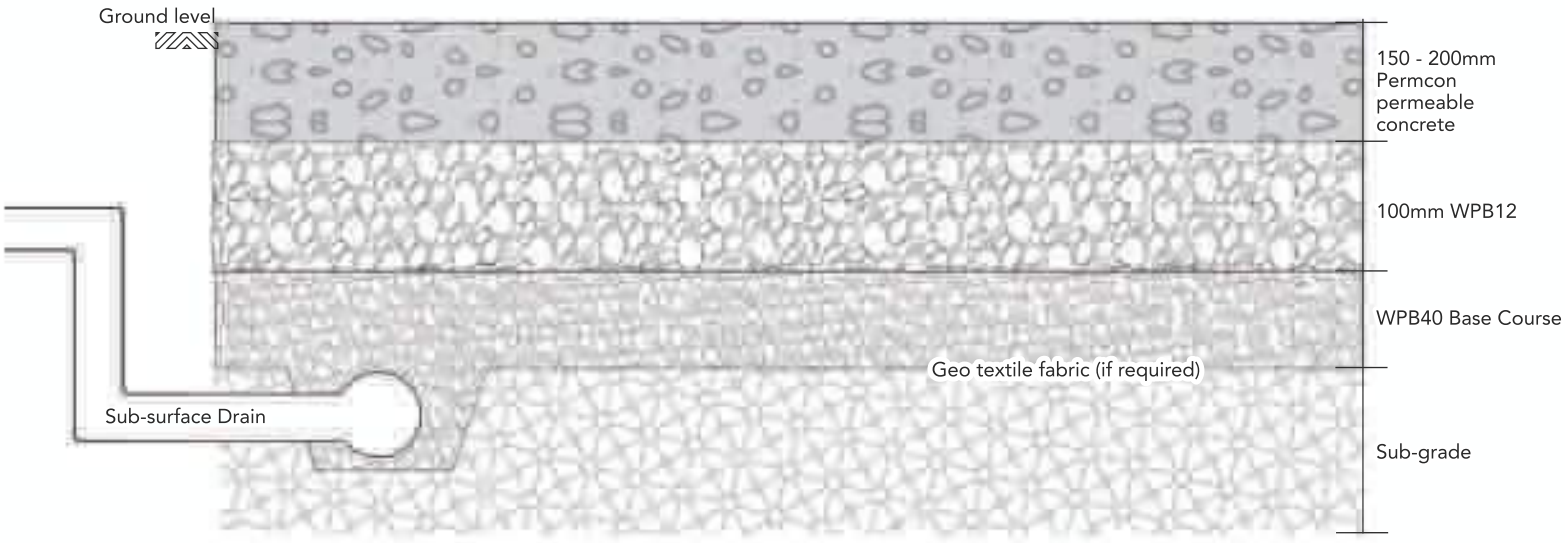
2. Providing the following conditions can be met:

**The topsoil is not prone to settling/subsiding and*

**The maximum weight of vehicles is limited [ie. residential light traf c/single unit residential driveways].*

Then in some circumstances it is acceptable to install Permcon on top of the existing top soil. However it is recommended that the advice of an engineer be sought.

Extended Water Storage



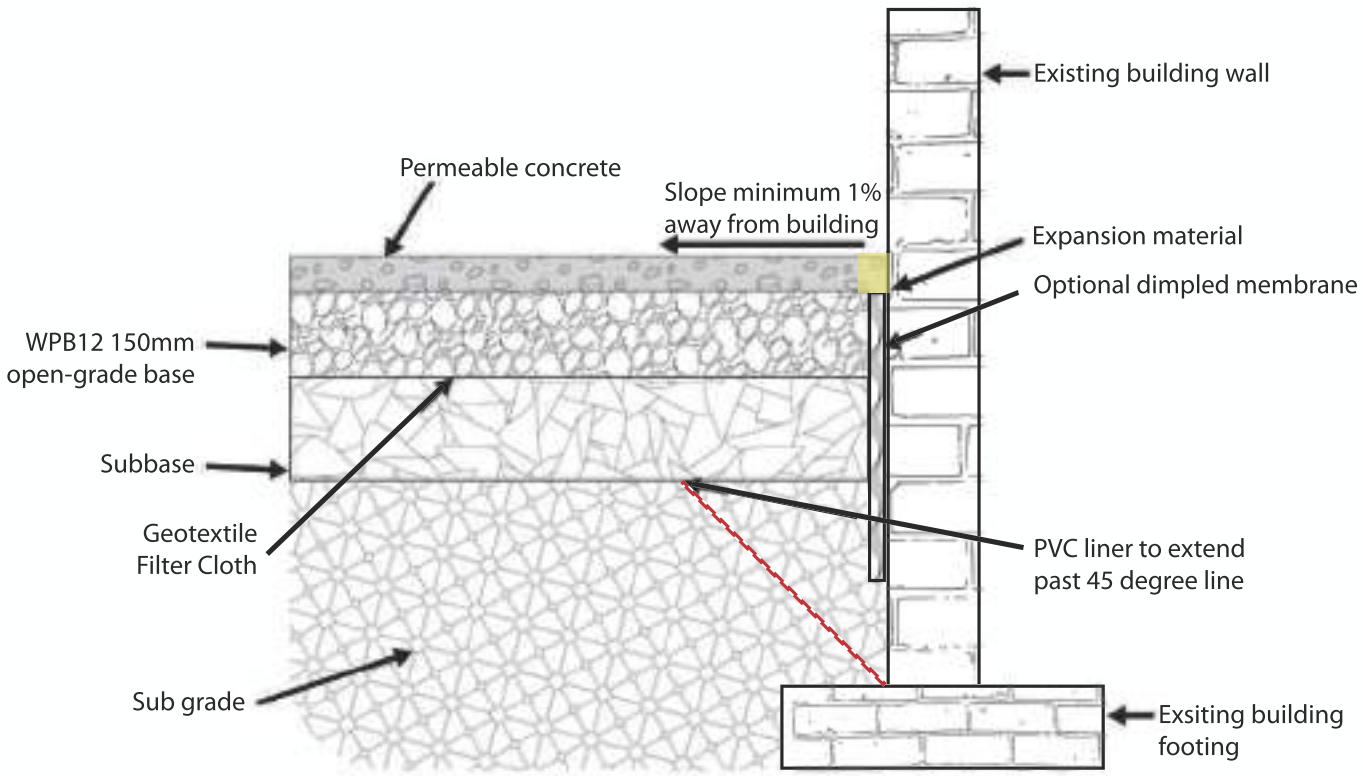
Note 1: retention volume formula = a x h x 0.3
a = area of paving m2
h = height between bottom of overflow outlet and base of form base course
0.3 = porosity of perm base course

Extended Water Storage

If higher water volumes are required to be detained / retained in the permeable basecourse then we recommend reducing the WPB12 to 100mm in depth and adding a Layer of WPB40 underneath , this layer depth of the WPB40 to be designed to hold the required water volumes , the WPB40 should be installed and compacted at maximum 150mm layers to ensure adequate compaction in the system

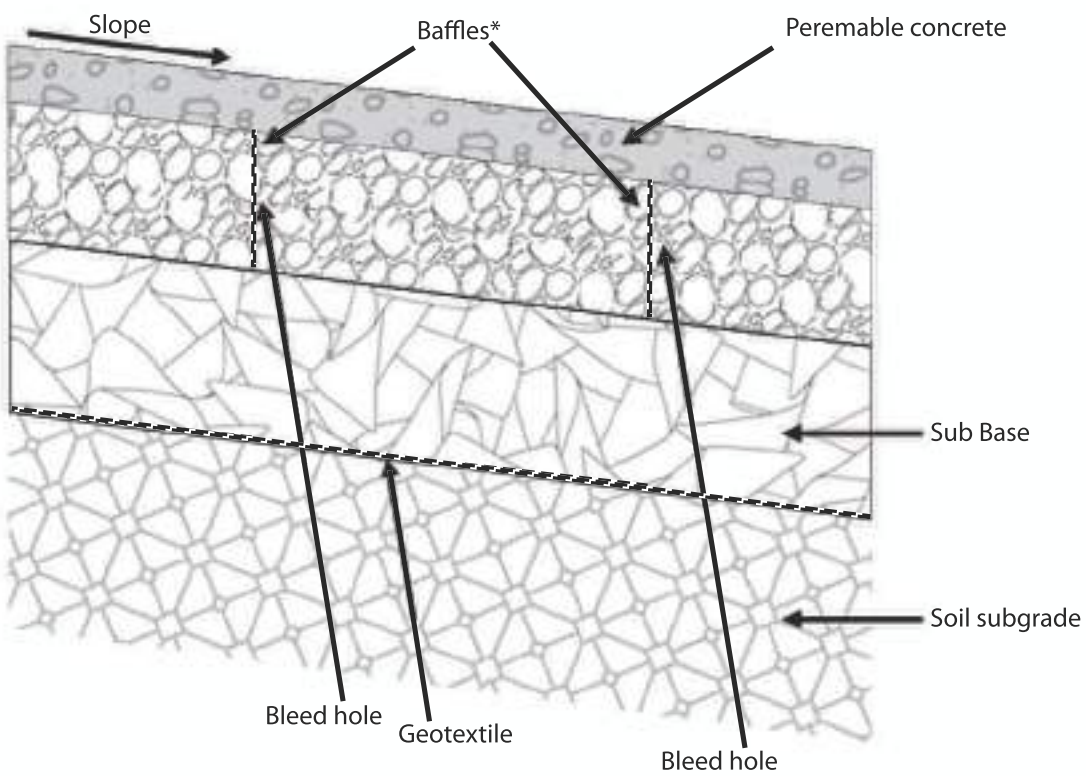
Permeable Base	Depth	Water Storage/m2
wpb12	100mm	
wpb40	100mm	60 litres
wpb12	100mm	
wpb40	150mm	75 litres
wpb12	100mm	
wpb40	200mm	90 litres
wpb12	100mm	
wpb40	250mm	105 litres
wpb12	100mm	
wpb40	300mm	120 litres

Foundation Wall Protection



Slopes

Maximum slopes before specific engineering required is 12% ,for slopes over 5% a baffle is recommended every 15 meters of slope length.



** Note: baffle typically 4mm thick plastic garden edge 127mm to 150mm in height*

Construction Materials (New Zealand)

Permeable Base Course Material [storage media]
The base course material shall be Winstones drainage aggregate “WPB12” or “WPB40” as designed.

Winstones Base Course Drainage Aggregate “WPB12” 2-12mm

SIEVE SIZE (MM)	WPB12	
	UPPER LIMIT	LOWER LIMIT
19.0mm	100	100
13.2mm	95	100
9.5mm	75	90
6.7mm	50	75
4.75mm	30	50
2.36mm	0	10

Specific Requirements
*The material shall produce less than 10% nes under a load of 120kN when tested in accordance with NZS 4407:1991 Test 3.10.
*The material shall contain no deleterious material such as organic or clay material.
*The broken face content shall be not less than 70% by weight and have 2 or more broken faces when tested in accordance with NZS 4407:1991 Test 3.14.

WPB12 will store approximately 400litres/m3, or when laid 100mm thick, will store approximately 40litres/m2

Table 3 - “WPB40” grading envelope

WPB40	37.5	26.5	19	13.2	9.5	6.7	4.75	2.36	1.180
MAX	100	87	76	66	58	50	44	0	-
MIN	100	84	71	59	50	42	36	0	-

Table 5 - Characteristics of Greywacke WPB12 and WPB40

PROPERTY		STANDARD	TEST METHOD	RESULT
SOURCE	Solid Density	NS4407:1991	Test 3.7.2	2.72t/m3
	Abrasion Resistance (Los Angeles Test)	NS4407:1991	Test 3.12	~11%
	Weathering Quality	NZS3111:1986	Test 15	AA
	Crushing Resistance	NZS3111:1986	Test 14	450≥
PRODUCTION	Permeability	Volume 2, Section 10.6 "Method of soil laboratory testing" by K.H. Head		k = 7.0 -3m/s
	Broken Face Content	NZS4407:1991	Test 3.14	100%
	Cleaness Value	NZS3111:1986	Test 13	70≥
OTHER	Maximum Dry Density	NZS4402:1986	Test 4.2.2	WPB12~1.65 t/m3 WPB7~1.60 t/m3
	Minimum Dry Density	NZS4402:1986	Test 4.1.1	WPB12~1.45 t/m3 WPB7~1.45 t/m3
	Total Voids % (From Maximum Dry Density Data)			>40%

Permcon Continuous Pour Permeable Concrete Paving System
Is specifically designed mix with strict batching controls.

Base course Thickness and Geotextile Filter Cloth Classication
See Table 1 under Applications - Sub-grades weaker than a CBR of 5 will require specific design.

Geotextile Filter cloth
Non woven Polypropylene Geotextile fabric type set out as in Table 1 under Applications.

Geogrid (Subgrade reinforcement)

For pavement construction using geogrids over very soft subgrade (CBR below 5) it is recommended not to use vibrating compaction equipment. This is to reduce the possibility of "livening" of the soft subgrade and pumping of soil particles up into the basecourse before sufficient interlock has been achieved with geogrid.

If the subgrade is livened as a result of over-compaction and (or) excessive water, roading construction should be put on hold to allow constructed work to set up before proceeding with subsequent layers.

The first layer thickness should be 150 to 200mm thick. Truck loads of sub-base shall be tipped into stockpiles on the sub grade and not tipped directly on geogrids.

The sub-base stockpiles should be spread by mechanical plant such as loader with an opening bucket or excavator bucket. The first layer should be carefully static rolled with a small number of passes using a light roller to create a grid/aggregate interlock. If pavement was designed for multi layers of geogrids, all additional layers should be also carefully static rolled a small number of passes.

If construction is taking place in wet conditions and pumping is likely, a layer of geotextile should be placed beneath layer of geogrid.

Considering the fact that tri-axial geogrids have triangular apertures they may be placed on the subgrade either parallel to the road centre line or in the transverse direction. The width of overlap between adjacent rolls is dependent upon grading and thick ness of sub-base and the stiffness of the subgrade. The minimum overlap shall be 300mm and maximum shall be 600mm or as specified by the engineer. Overlaps must be maintained during the fillling operation. This is generally achieved by placing small heaps of fill locally over the overlaps ahead of the main filling operation. No traffic or site plant shall be permitted to travel on the geogrids prior to placing sub-base aggregate.

Compaction of unbound materials for sub-base and road bases shall normally be carried out in accordance with specifications for sub-base aggregate. Compaction of other lls shall be carried out in accordance with specifications for earthworks construction.

Planning and Preparation

Before commencing installation, assess the nature of the project. In particular, consider how Permcon Continuous Permeable Concrete System will manage rain, stormwater & runoff. On large surfaces it may be necessary to get the system hydrologically engineered to ensure the pavement can manage the required runoff capacity from a water management point of view. Ensure that each of the following is understood & completed prior to the actual start of the job.

1. Locate and mark the area to be paved.

2. Verify the location, type and elevations of edging around the perimeter.

3. Excavate ensuring that the sub-base foundation is appropriate for the amount of traffic it will be subjected to. The required excavation depth for either the Detention or Inifltration system will need to be calculated based on a combination of Table 1 and the amount of water the system is expected to store (refer to section 2, for the storage capacity of the chosen base material i.e. Winstone's drainage aggregate). Ensure the sub-grade (soil) is compacted to the specified density and moisture content.
Note: Compaction of the soil sub-grade should be to a minimum of 5% CBR for pedestrian areas and residential driveways, and a minimum of 10% CBR for vehicular areas. Stabilisation of the soil and/or base material may be necessary with weak or saturated soils, or when subject to high wheel loads. Compaction will reduce the permeability of soils. These conditions may require the use of drains in open graded bases.
On site sub-grade CBR can be determined by Scala Penetrometer Test as per NZS 4402:1986.

4. Once excavation is complete, ensure that the sub-grade is free from standing water, uniform and even. There should be no organic material or debris on the site prior to the start of the job.

5. Where necessary, it is acceptable to apply bedding sand immediately on top of the sub-grade [prior to applying the geotextile] in order to even out any undulations/holes on the surface of the sub-grade.

6. The site is now ready for installation.
Note: A sloping site will have less storage capacity than a level site as water will resurface at the lowest point. This can be overcome by encouraging crossflow (through the installation of weirs) or concentrating storage capacity at the lowest point of the design. Alternatively, a drainage coil can be incorporated into the design allowing water to disperse to another drainage system.

Installation

1. Prepare site
Mark or peg out area where Permcon is to be installed ensuring the relevant erosion and sediment control measures are in place, if required. Excavate to required depth.

2. Lay sub base if required and under drain.
If specified, lay sub base over the entire area, checking seams are sealed and there are no stress points or tears.

If included, lay underdrain (with filter sock, if specified), on 300mm minimum depth gravel with 0.5% slope (50mm drop over 1m length). Connect to stormwater outlet with watertight fit. Backfill carefully over underdrain with 50mm basecourse.

3. Fit Geotextile
Place geotextile over subgrade material, or over impermeable layer and underdrain to prevent clogging by fine sediment in runoff.

4. Place permeable basecourse
Place gravel permeable basecourse material to level and depth specified. Permeable basecourse gravel to be washed crushed rock (not scoria) with 30% minimum voids. Place layer of geotextile over permeable basecourse.

5. Install Permcon
Ensure Permcon permeable concrete is installed by certified PCNZ permeable concrete installers as per PCNZ specification.

6. Restore site
Remove construction materials and reinstate surrounding area, regrassing distrubed areas. Remove sediment and erosion controls Check underdrain connections to stormwater are clear of blockages.

General Maintenance

Driveways, Footpaths and Patios

1. Sweep surface regularly.

2. In locations where the leaves drop on the pavement, regular cleaning/blowing of leaves to stop organic sediment decomposing on the surface and joints.
This is the most important activity in maintaining your Permcon permeable concrete paving system.

3. Every year – general cleaning/weed/moss control with a Rotary head cleaner or hosing.

4. Once a year inspect after a rain event , if there is standing water or puddles on pavement then permeability has been compromised , contact your local representative for information on restorative actions

Car Parks

1. Every year – general inspection.

2. Every year – general cleaning with regen sweep truck or similar

3. Every ten years – check the permeability of the system. If the water stands for 1hr or has a permeability rate of less than 250mm/hr proceed with the corrective maintenance.

4. Once a year inspect after a rain event , if there is standing water or puddles on pavement then permeability has been compromised , contact your local representative for information on restorative actions

Frequently Asked Questions

How long does permeable concrete last?

Permeable/pervious concrete, when properly installed and maintained can last 25-30 years.

Can permeable concrete clog up?

A general maintenance regime of sweeping or surface washing will minimise the opportunity for the product to clog. In situations where this does occur an industrial vacuum can be used to clear the void.

How long does it take before the system clogs up?

It's difficult to be specific due to every location being different and dependant if it's located in the right position and how much sediment there is in the runoff. The location of where Permcon is installed plays an important role with the sediment loading and hence life span of the system. Areas that will be subject to organic loading (leaves from trees) should be carefully considered together with a sweeping (without vacuum) regime. Other locations which will have a high clay content in the runoff should be avoided.

What kind of aggregates can I use for the base course?

Specifically designed drainage aggregates that are structurally sound when fully saturated/submerged with water. Normal GAP types of aggregate are not suitable and will lead to pavement failure.

What is the void ratio in permeable concrete?

The amount of void in permeable concrete can vary in the range of 15-30%. Permcon usually has a consistent void structure of 20-25%.

What is the typical infiltration rate for Permcon and how does this compare to recognised standards?

Permeable pavements have a very high permeability and are approximately tenfold the requirement to allow for sediment loading to achieve longevity.

How can I test the permeability of my pavement system?

One of the test methods is ASTM C1701/C 1701M -09 "Standard Test Method for Infiltration Rate of In Place Pervious Concrete" is simple and easy to conduct in on–site locations.

Can permeable concrete be pumped into an installation?

Like traditional concrete, there are a variety of different methods used in installing the product. However, given that permeable concrete is a low slump product it cannot be pumped into place like traditional concrete.

More Information

For more information on Permcon, including the name and location of product suppliers and permeable paving installation contractors, please contact.

Stuart Girvan +64 27 224 1361
sgirvan@permconnz.co.nz
info@permconnz.co.nz

Permcon

May 2022

Contact Details

New Zealand

Phone: +64 27 224 1361
Email: info@permconnz.co.nz
Website: www.permconnz.co.nz

Our market focus:

Domestic/Residential
Commercial
Community Infrastructure
Building & Construction

Proudly supplied by Firth concrete industries