HCC 07B: Permeable Paving

1.1 Introduction

This practice note[1] has been developed to provide general information on the minimum design and sizing requirements for permeable paving which can be used in residential and non-residential applications for on-site stormwater management.

1.2 What is permeable paving?

Permeable paving is an alternative surface to concrete or other common impermeable surfaces and can be used to manage both stormwater quantity and quality. When properly constructed and maintained, permeable paving is a versatile stormwater management device that can be used to treat or replace impermeable surfaces.

1.3 Description

Permeable paving means a pavement consisting of a layered construction to enable rainwater infiltration to ground soakage below or discharge to an underdrain which is connected to an approved stormwater outlet. This provides a permeable surface layer which can be specifically designed to infiltrate rainfall for up to the 10 year ARI event.

Permeable paving consists of a permeable wearing surface that is bedded in sand/fine gravel, laid over a gravel basecourse. A number of different surfaces are commonly used for permeable pavements. These include:

- Interlocking concrete block paving with permeable gaps between the pavers
- Interlocking permeable concrete block paving
- Concrete grid pavers such as “Gobi Blocks”
- Porous concrete
- Reinforced gravel or turf (Plastic grid pavers)

Infiltrated stormwater is slowed down, temporarily stored and slowly released by the basecourse, resulting in attenuation of stormwater peak flows. Stormwater passing through a permeable system receives treatment due to settling, filtration, absorption and microbiological action taking place in the bedding sand and basecourse.

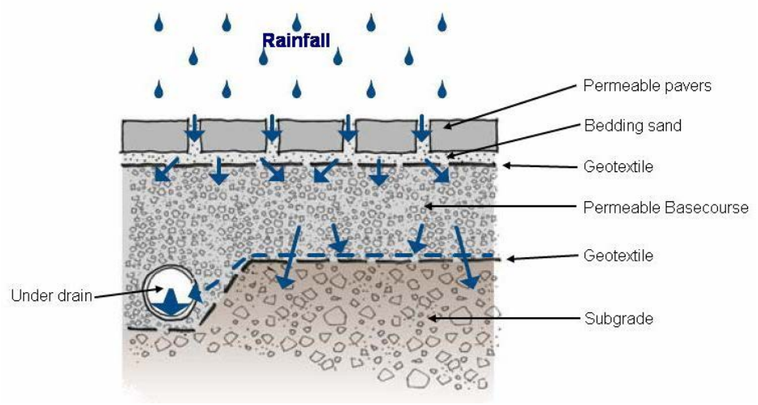

Figure 1: Typical layers in permeable pavement

In areas where geotechnical conditions are less sound, permeable paving needs an impermeable liner beneath the basecourse to prevent the infiltration of water into the adjoining soil. If a liner is necessary, it needs to be protected from puncturing by the use of a heavy-duty geotextile above the liner.

Guidance within this practice note specifically applies to:

- ‘Porous blocks’ (where the pavers are permeable) and ‘Porous gaps’ (where pavers are not permeable and the infiltration takes place through the gaps or joints between the pavers).
- Reinforced turf or concrete grid pavers.
- Private driveways and parking areas.
- Areas less than 250m^2 of permeable paving area. While this practice note is still relevant to larger areas of permeable paving, specific design is recommended to limit risk and ensure correct design of the drainage system and edge restraints.

1.4 Where can permeable paving be used?

Permeable paving can be used in circumstances where a hard surface is required, but as an alternative to impermeable surfaces like concrete. For example in carparks, driveways and low use right of ways.

Permeable paving is a self-mitigating surface which is considered capable of providing full hydrological mitigation for the total area that it covers. Permeable paving is better suited to driveways and parking areas on relatively flat areas with less than 5% slope.

It should not be used in areas where geotechnical conditions are less sound unless it includes an impermeable liner.

The use of permeable paving may be identified within an approved Water Impact Assessment or Integrated Catchment Management Plan as a water efficiency measure to mitigate stormwater runoff from your site.

1.5 Advantages of permeable paving

Permeable paving offers a number of benefits, including:

- ***Improved water quality by filtering out contaminants.***
- ***Improved hydrological response of stormwater peak flow by holding and releasing water in a controlled manner.***
- ***Reduces volume of flow discharge to the stormwater system and also supports groundwater recharge.***
- ***Being land efficient by allowing the use of paved area to treat its own stormwater which reduces the need for land for other treatment devices.***
- ***Providing amenity/landscape feature, especially when different colour pavers are used.***

1.6 Minimum design requirements

1. **Paving layer**: Paving may consist of concrete block pavers with permeable gaps, porous concrete blocks, concrete grid pavers with an approved permeable planting material, or reinforced turf with an approved permeable planting media. Pavers in walking areas should be selected so that they provide a safe walking surface. The use of porous concrete will require specific design and assessment.
2. **Jointing material**: A jointing material is required for concrete block pavers. This should be either sand or 2 to 5mm fine gravel size clean crushed hard stone (depending on the type of paver chosen), or approved equivalent, installed as per manufacturer’s specifications.
3. **Bedding**: Pavers are to be bedded on a maximum 25mm of sand bedding or 2 to 5mm fine gravel size clean crushed hard stone (depending on the type of paver chosen) layer as per manufacturer’s specifications.
4. **Geofabric**: A geofabric liner is required between the basecourse and the bedding layer to prevent ingress of the bedding sand into the basecourse. A geofabric liner is also required between the subgrade and the basecourse.
5. **Basecourse**: A minimum of 200mm basecourse which has a void ratio of at least 30% is required. Basecourse material should be 12mm max gravel size clean crushed hard stone, or approved equivalent. Scoria should not be used for basecourse.

Note: this basecourse design assumes a subgrade California Bearing Ratio (CBR), of 3% and a maximum residential driveway/parking bay design traffic loading of 2,000 Equivalent Single Axle (ESA). Basecourse depths may only be reduced if soil testing is carried out to determine actual CBR values. For other traffic loadings a specific design is required.

[1] Three Waters Management Practice Notes are Hamilton City Council controlled documents and will be subject to ongoing review. The latest version can be downloaded from the Hamilton City Council website: http://www.hamilton.govt.nz/our-council/council-publications/manuals/Pages/Three-Waters-Management-Practice-Notes.aspx

6. **Onsite detention:** Permeable paving can be designed to provide detention by provision of a gravel layer underneath the usual basecourse. **Specific engineering design is required for this solution.**

7. **Under drain**: A 200mm strip drain is to be placed along the length of the down-slope side of the pavers. The bottom of the basecourse (subgrade level) is to slope towards the strip drain to collect water draining through the permeable basecourse. The bottom of the strip drain is to be placed 50mm below the bottom of the permeable basecourse to provide positive drainage into the strip drain. The strip drain is to drain to the nearest approved stormwater outlet.

   Note: for larger areas more than one drain may be required.

8. **Surface drainage**: A catchpit should be provided at the lowest point of the paved area where the underdrain drains to the approved stormwater outfall. This catchpit should provide access to the underdrain for maintenance and also capture excess flows which are unable to drain through the paving system.

9. **Liner**: If the site or downstream areas are geotechnically unstable, permeable paving cells need to be contained within a 250µm polyethylene impermeable liner. The liner needs protection against puncture with placement of geotextile, Propex 801, or approved equivalent. Care must be taken during construction not to puncture or otherwise compromise the integrity of the liner.

10. **Edge beams**: Edge beams are required around the permeable paving to prevent pavers from getting displaced. This will also facilitate terminating the upper ends of geotextiles and the liner (if used).

11. **Catchment area**: The permeable paving is designed to mitigate the rain falling directly on the paving area. Other areas draining towards the permeable paving should be limited to avoid overloading the paving. Other permeable areas which may generate sediment loads should not drain onto the permeable paving area. Care should be taken to protect permeable paving from sediment when areas which are adjacent to it are disturbed. Stockpiles of material must not be stored on top of permeable paving.

12. **Placement**: Placement should be to the manufacture's specifications.

13. **Slope**: It is important to obtain the correct location and slope for the permeable paving. Shallower slopes are better for permeable paving. Maximum slopes are:

    - Permeable paving longitudinal slope < 5%
    - Permeable paving cross-slope < 2%

    The surface of the permeable paving is to slope towards collector grates/catchpits to collect the larger storm events where water flow is both through the pavers and across the top of the pavers.

14. **Clearance:** Provide sufficient clearances from buildings and structures. As a minimum a 45° line from the bottom of the permeable paving basecourse should not intersect a footing, or a structure, subject to a minimum of 1m clearance measured on plan, unless installed with a protective impermeable liner.

1.7 Construction

The construction sequence is important for the successful performance of the permeable paving. No sediment-laden stormwater should be allowed to enter the permeable paving area, as it will clog-up the storage voids and the permeable surface. All work surrounding the permeable paving should be completed and all surfaces surrounding the permeable paving should be stabilised (i.e. paved or grassed or vegetated, as appropriate) prior to commencing the permeable cell construction. If work on the permeable paving needs to commence before the rest of the site is stabilised or work that is likely to generate high sediment loads takes place after permeable paving has been laid, then the whole paving area needs to be protected with a geofabric blanket which should only be removed once the site has stabilised.

After construction, no runoff should be allowed to enter the basecourse directly. All water should enter the basecourse only through the permeable paving (i.e. DO NOT pipe any runoff direct into the basecourse). This is to prevent clogging of the storage volume.

1.8 Maintenance

Maintenance is a key element to ensure long-term performance of permeable paving. Recommended maintenance actions are presented below for small on-lot installations such as driveways and limited parking bay areas.

- Regular visual inspections and cleaning of the permeable paving surface, outlet and overflow as part of house/yard upkeep. Regular cleaning of the paving surface to include washing/blowing of leaves and other organic sediment to prevent clogging. An indication of clogging is if water ponds on the surface for 1 hour after a rainfall event or the tested infiltration rate is less than 250mm/hr. If pavement is clogging, this may require corrective maintenance such as using a water jet/suction device with replacement of the jointing material.
- Every year – general cleaning/weed/moss control with a Rotary head cleaner or hosing.
- End of first year and every ten years – top up of joint chip or sand between pavers

Do

- Clean up leaves, mud and litter before they have a chance to clog the surface
- Brush the surface if any dirt collects on it and this will reduce the risk of it blocking and help stop weeds growing
- Remove weeds by hand or with a weed burner
- Refill jointing material from time to time

Don't

- Put soil, sand or similar material on the driveway that will block the surface and stop water soaking in
- Mix concrete on the driveway
- Pour liquids such as oil on the surface
- Allow the garden areas to drain onto permeable surfaces as this can allow soil to wash into the surface and block it
- Use weed killer or other eco-toxic chemicals on the surface
- Use high pressure water to clean the paving unless it is part of a corrective maintenance procedure to unclog the permeable surface.

1.9 SUMMARY OF PLANNING REQUIREMENTS

As long as you comply with the minimum design requirements outlined in this practice note, and the permeable paving is installed to manufacturer's specification then specific engineering is not required, nor is a building consent.

If detention is being provided within the permeable paving design, then the detention component will need to be designed by a suitably qualified person based on best practice guidance. In this circumstance, as-laid plans will be required for the permeable paving detention system, authorised by a registered drain layer, and shall be provided to council.