PERMEABLE SURFACES

Concrete paths and driveways are often laid around buildings but it is worth considering more sustainable methods using permeable surfaces.

By Steve Dunn, Principal, and **Katie Bailey,** Landscape Planner, Boffa Miskell Ltd (Registered NZILA Landscape Architects)

Permeable surfaces help reduce storm-water loads on the pipe infrastructure by absorbing or detaining rainwater. Any contaminant in the water is also filtered by the soil before it reaches waterways.

Types of permeable surfaces

To be effective, permeable surfaces typically need at least 30% void space. There are a range of options (see Table 1).

LOOSE AGGREGATE

Loose aggregate, such as gravel, lime chip and crushed glass, can move around in high-use areas. A retaining edge, for instance, a timber or concrete nib edge, would be useful for narrow paths. Laying a geotextile fabric over the base material helps stop the aggregate being pushed into the sub-base.

Fine lime chip can pack down to form an impervious layer so coarse, open grades are preferred, but it can collect on the soles of footwear and 'track' inside buildings.

Regular maintenance is needed to control windblown weed seeds, which can colonise the loose top layers, but these can be easily pulled out when young.

POROUS TURF PAVING

Porous turf reinforced concrete open block paving or plastic grids are often used where traffic loads need to be spread to avoid compacting the soil. They are useful for vehicle access areas and laying over tree root plates where water needs to get to the growing zone below.

Extra maintenance is needed when growing grass between units as the concrete can absorb and draw water from the soil limiting grass growth. Ensure adequate regular moisture and regularly fertilise the grass to ensure ongoing growth.

Alternatively, the voids can be filled with pervious sands or gravels for a textural effect.

OPEN JOINTED BLOCKS WITH PERVIOUS JOINTS

Interlocking concrete or stone units have spaces between their joints that are filled with a pervious material, such as fine gravel or sand. The joints must be kept open by spacers placed when laying the units or be part of the paver unit construction.

TIMBER DECKING

Timber decking around buildings allows water to fall through to the ground below. The ground must slope away from the building. Decking can give easy access to buildings but will get slippery if slime and fines are allowed to collect on the surface.

Regular cleaning is needed, particularly for shaded decks, and an overlay grid or raised inserts may be needed for ramps where additional slip resistance is required.

PERVIOUS CONCRETE AND ASPHALT

Pervious concrete and pervious asphalt have a high porosity due to the large proportion of void spaces – they have little or no fine aggregate. They are useful for large areas but need specialist manufacturers and installers to ensure quality and performance.

Over time, fines may collect in the voids and these would need to be cleared through industrial vacuuming.

RESIN-BOUND AGGREGATES

Resin is used to bind aggregates or crushed glass together, and voids form between the aggregates. This is often seen as a decorative paving around the base of tree pits. It requires specialist applicators, and its durability has not yet been tested.

As with porous concrete or asphalt, fines that collect in the voids need to be regularly removed.

Is the site suitable?

Generally, permeable surfaces are only suited for slopes up to 20°.

Check the infiltration capacity of the subsoil to ensure it will be sufficient and consider traffic volumes or loadings.

The finished ground levels will need to:

- be below the floor level, as specified in the Building Code (see Figure 1)
- have a positive fall away from any buildings.

Some councils have standards for permeable paving that must be met, for example, Rodney, Waitakere and North Shore City councils.

Drainage important

Where there is limited ground infiltration, overland flow paths or subsoil drains are recommended to ensure water does not pond for long periods during heavy rain events. Rain gardens and detention swales can also be constructed on larger sites as part of a rainwater collection and dispersal strategy.

In some cases, a combination of hard paving with a pervious material, such as paving slabs set in a gravel path, allows good pedestrian access with a porous surround. Subsoil drainage is needed in the lower levels of the sub-base to remove excess water that is not absorbed.

Maintenance

Durability and maintenance depends on the construction:

- Porous asphalt and concrete typically require industrial vacuuming every 2–3 years to remove grit and sand that can block voids and reduce effectiveness.
- Open jointed blocks usually require no more maintenance than standard concrete pavers.
- Weed seeds blown by the wind can collect in loose materials and will need to be removed.

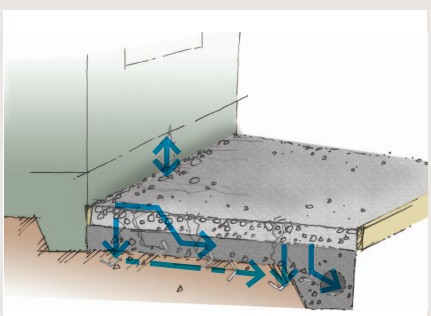
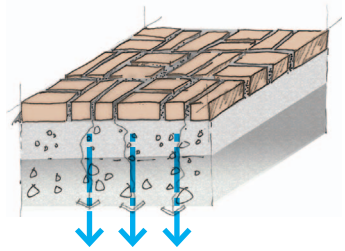
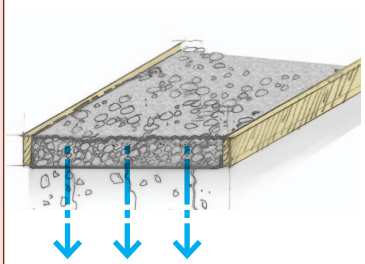
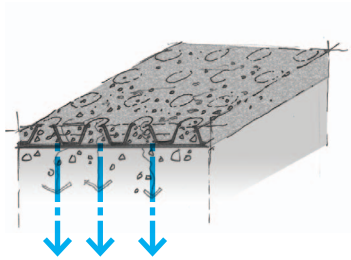
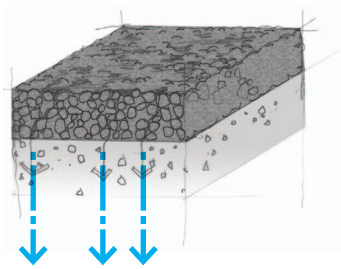


Figure 1: The finished ground level of a permeable surface needs to be at least 225 mm below the finished floor level and fall away from the building.

Table 1: Options for permeable surfaces.

Options	Key considerations	Benefits	Drawbacks
Open jointed blocks with pervious joints 	Retaining edge usually required to secure edge of paved areas. Best suited to residential driveways, pedestrian walkways in parks/ residential areas and low-volume car parking areas; most secure in traffic areas when laid in herringbone pattern at 90° to traffic flow. Where pavers are not permeable, check suitable sub-base drainage and spacers placed between units to ensure gaps are retained.	Cost variable but comparable to conventional paving systems. Range of colours, shapes, sizes and thicknesses available. Thicker pavers are suitable in heavier use traffic areas. Visually attractive.	Can be an expensive option. Not suited for use on slopes over 5%. Not suited for applications where sediment movement/generation is high, e.g. near construction sites, flood prone areas. Moderate maintenance – may require mechanical suction brushing annually, replenishment of joint material, repair of any rutting, removal of windblown weeds in joints.
Loose aggregate 	Retaining edge required to secure loose aggregates. Best suited to driveways, pedestrian walkways in parks, low-use car parking areas or residential applications.	Inexpensive, easy to install. Range of suitable colours and grades available, e.g. coloured pebbles, scoria, lime chip. Completely natural material, environmentally benign, easy to recycle and reuse.	Some periodic maintenance where loose aggregates spill out of edging; may need top-up every few years; removal of windblown weeds. Less suited to: • steep sites as aggregate will move • high traffic areas as it will move, compact with use and form potholes. Not well suited to areas to be frequently used by wheelchairs, push chairs, bicycles and roller blades.
Porous turf paving or plastic honeycomb units 	Both systems suited to weight-bearing tracks, parking and road verges but gravel more suited to high traffic areas than grass. Laid directly onto parent material (not topsoil). Where land is strongly sloping, a timber edge is required, with additional drainage provisions. Minimum 4% slope from mid point to sides to create positive camber for water runoff.	Suited to use in wide range of residential, commercial and industrial applications with gravel or grass fill. Honeycomb cell structure very strong as units interlock. Some products are produced in New Zealand from ultraviolet-stabilised recycled plastic. Relatively easy to install and cost effective compared to concrete alternatives. Plastic systems light and stackable for easy transportation.	Limitations on the potential to reuse or recycle materials when they reach the end of their useful life. Gravel material will periodically need to be topped up. Has more limited capacity to handle high traffic volumes if voids filled with soil and grass (but useful for overflow parking areas) – grass won't grow if cars are using the surface too regularly. Subsurface needs to be carefully designed to withstand level of use, otherwise trenching may occur. Appearance – parts of the units being visible may be undesirable.
Resin-bound aggregates/pervious asphalt and concrete 	Resin-bound best suited to applications such as tree pits, courtyards, pedestrian and light vehicular use – can withstand heavy traffic use if laid over concrete or asphalt (but then not permeable). Porous asphalt and concrete best suited to parking areas, walkways, and roading; with proper basecourse preparation, can handle heavy traffic volumes. If resin-bound aggregates are used in close proximity to tree trunks, a weaker mix should be installed so that it breaks away as the trunk expands. Resin-bound aggregates must be in a grade range between 3–10 mm.	Both systems fast and easy to construct. Cost varies – porous asphalt is approximately the same as conventional asphalt; porous concrete and resin bound aggregates are more expensive. Can form continuous, flexible surfaces. No or little maintenance requirements; bound aggregate to be cleaned with white spirits, water blaster at low pressure or mechanical sweepers. Porous asphalt can last for decades and is suitable for use in extreme climates.	Contaminants on the surface will be swept through to base course and eventually the soil. However, this can be a benefit as soil microbes have the opportunity to break down contaminants such as suspended solids, metals, oil and grease. Limitations on the potential to reuse or recycle materials when they reach the end of their useful life. Both systems require specialist installation. Finishes may not be as desirable – resin-bound aggregates tend to have a glossy finish; porous asphalt/concrete tends to be coarser than conventional mixes.