CAUSEWAY

permeable concrete pavers
PERMEABLE PAVING

from Austral Masonry

Causeway permeable paver systems provide a hardstand and drainage solution in one product.

The patented Causeway system allows rain water to infiltrate through small channels formed on the ends and sides of the concrete pavers, passing into a prepared sub-base. The water is then detained, filter treated and dispersed, discharged or directed for re-use.

Rather than collecting water run-off, channelling it through open drains and subsequently treating it, water engineers in many parts of the world are solving the problem at the source using permeable paving solution as a more cost-effective and environmentally productive approach.

Depending on project requirements, either an infiltration system which allows drainage through to the ground water system, or a tanked system which captures water run off, can be used.

Permeable paving systems can remove sediments and some nutrients, heavy metals and hydrocarbons from polluted stormwater via the processes of absorption, filtering and biological decomposition.

In fact, a field study\(^2\) conducted in 2003 of four different types of permeable paving installed in a parking area found no oil, fuel or lead in the water infiltrated through the paving, even though these pollutants were present in the direct surface runoff from the impermeable asphalt control sample. Field studies have also shown permeable pavement to be very effective at retaining dissolved metals.

A further study* found that the impervious area on a road surface reduced from 45% to 5% when permeable pavements were used. Subsequent monitoring found that surface runoff water quality improved and there was no increase in groundwater contaminants.

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*We Are Brickworks*

*Bottom Right: Causeway Almond*
For smart and functional designs
Causeway permeable pavers are a unique product which features small nibs on each side which create a gap between pavers which allows water to penetrate between them.

An intelligent hardstand solution, Causeway pavers can reduce drainage infrastructure requirements and the costs associated.

Causeway can be used in a tanked system if water run off is to be reused, or an infiltration system, were the water is allowed to drain into the natural groundwater system.

**Applications**
- Landscaping
- Domestic Driveways
- Car Parks
- Low to Medium Volume Pedestrian Traffic
PERMEABLE PAVING

Causeway
Size: 230 L x 115 W x 80 H mm
Weight (each): 4.3 kg
Coverage: 38 units per m²
CAUSEWAY

benefits

Causeway permeable pavers offer all the benefits of standard segmental pavers with added advantages that include: the potential to reduce drainage infrastructure, ability to capture run off on site and re use, and the ability to filter contaminants from the run off as it filters through the sub base to recharge the water table. The full range of benefits Causeway permeable pavers can offer include:

**Hardstand and Drainage Infrastructure**
Most hardstand solution are simply a solid platform, permeable pavers create a hardstand and drainage solution in one product.

**Potential to reduce costs**
Using permeable paving can reduce the investment required in sub surface drainage infrastructure and remove the need to up-size culverts and water courses.

**Water reuse**
When used in a tanked system, water can be collected and reused. Permeable pavers offer safe collection, detention and discharge with no dangerous open drains or pits.

**Design to filter out contaminants**
A permeable paving system can be designed to filter contaminants and pollutants as it drains.

**Permeable pavers allow ground movements**
Because a permeable pavement is composed of many small units, it will allow ground movement without cracking and the need for remediation.

**Elimination of shrinkage, cracking and joint stepping**
Because they are cured when supplied, permeable pavers will not shrink or crack as a result of curing. Pavers also will not suffer from cracking or joint stepping that results from ground movements, as the small units allow some movement without degradation.

**Ready access to underground services**
Underground services can be accessed by simply removing the desired section of pavers to access the area below.

**Low embodied energy**
Permeable pavers are cured in temperature controlled kilns instead of fired kilns which means their production requires less energy than some competing products.

**Designed to Last**
Permeable paved hardstands are estimated to have a design life of 25+ years. At the end of this design life they simply need to be re bedded, with the same paver units re used.

**Reduced installation time**
Permeable pavers can be machine laid with the ability to lay up to 5000m² in 6-9 days.

**Strong, durable and weather resistance**
Composed of strong, dense concrete, Austral Masonry permeable pavers will withstand considerable impact, loads and weather events.

**Rust, rot and termite resistant**
Because they are made from concrete, Austral Masonry’s permeable pavers are impervious to rust, rot and termites.

**Once installed, segmental block pavers create an instant hardstand.**
No curing time is required with permeable pavers. They are supplied ready as a cured product and can be loaded immediately after installation.

**Lower lifecycle costs**
Permeable pavements have a low life-cycle cost because their standard maintenance costs are lower when compared to concrete pavements.

**Simple remediation measures**
Simplified and less costly remedial measures required are required with segmental paved hardstands. Remediation measures generally relate to the sub base with re leveling required. This is comparatively affordable compared to remediation required for some competing hardstand solutions. If broken individual units can be replaced if they are cracked or damaged.
The Causeway permeable paving system provides effective on-site water management and treatment in the following ways:

- Organic matter and loam are caught on the geotextile and held in the layer of 5mm aggregate.
- Oils and heavy metals coat the surface of the organic matter and loam.
- Natural microbial filament growth in the sub-base digests low level hydrocarbon pollution.
- Severe hydrocarbon contamination can be treated by seeding with specialist microbes and slow release fertilisers.

The Causeway permeable paving system provides water management assistance by:

- Minimising the volume of runoff from a development;
- Preserving pre-development hydrology;
- Capturing and detaining, or infiltrating, flows up to a particular design flow;
- Utilising water sensitive urban design techniques without compromising the hard standing surface requirements such as parking or traffic-ability;
- Enhancing groundwater recharge or preserving pre-development groundwater recharge;
Causeway pavers can be used in various applications including; landscaping, domestic driveways, car parks and pedestrian applications.

For industrial applications, and those where the pavement is likely to hold heavy loads please contact your local Austral Masonry office who will offer advice relevant to specific site conditions.

<table>
<thead>
<tr>
<th>Product</th>
<th>Range</th>
<th>Weight</th>
<th>Size</th>
<th>Coverage</th>
<th>Slip Resistance Class</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Causeway</td>
<td>4.3</td>
<td>4.3</td>
<td>230L x 115W x 80H</td>
<td>38 Units per m²</td>
<td>Almond - P5, Natural - P5, Terracotta - P5, Charcoal - P5</td>
<td>Landscaping, Pedestrian, Domestic Driveways, Car Parks</td>
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**Specifications and additional information**

<table>
<thead>
<tr>
<th>Content</th>
<th>Cement, sand, aggregate, colour oxide</th>
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</thead>
<tbody>
<tr>
<td>Dimensional Category</td>
<td>DPB1</td>
</tr>
<tr>
<td>Characteristic Breaking Load (kN)</td>
<td>&gt; 10</td>
</tr>
<tr>
<td>Abrasion Resistance Index</td>
<td>&lt; 5 (for roads)</td>
</tr>
<tr>
<td>Slip Resistance Class</td>
<td>p5 tested to AS 4586</td>
</tr>
<tr>
<td>Salt Tested to AS/NZS4456.10</td>
<td>Yes</td>
</tr>
<tr>
<td>Liability to Effloresce</td>
<td>Nil to Slight</td>
</tr>
<tr>
<td>Manufacturing and Test Standard</td>
<td>AS/NZS4455, 4456 and 4586</td>
</tr>
<tr>
<td>Ordering Requirements</td>
<td>Made to Order (Minimum Order Qty applies)</td>
</tr>
<tr>
<td>Lead Time</td>
<td>4 - 6 Weeks</td>
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<tr>
<td>Bulk Ordering</td>
<td>Requires extended lead time of more than 6 weeks</td>
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</table>
CAUSEWAY

general information

Recommended Laying Patterns

- **Best**
  - Herringbone

- **Better**
  - Basket weave or Parquet

- **Good**
  - Stretcher bond

* Not suitable for driveway applications

Slip Resistance Classifications

<table>
<thead>
<tr>
<th>Class AS/NZS 4586 – 2004</th>
<th>Class AS 4586 – 2013</th>
<th>Four S</th>
<th>TRRL</th>
<th>Contribution of the pavement to risk of slipping when wet</th>
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</thead>
<tbody>
<tr>
<td>V</td>
<td>P5</td>
<td>&gt;54</td>
<td>&gt;44</td>
<td>Very Low</td>
</tr>
<tr>
<td>W</td>
<td>P4</td>
<td>45-54</td>
<td>40-44</td>
<td>Low</td>
</tr>
<tr>
<td>X</td>
<td>P3</td>
<td>35-44</td>
<td>-</td>
<td>Moderate</td>
</tr>
<tr>
<td>Y</td>
<td>P2</td>
<td>25-34</td>
<td>-</td>
<td>High</td>
</tr>
<tr>
<td>Z</td>
<td>P1</td>
<td>&lt;25</td>
<td>-</td>
<td>Very High</td>
</tr>
</tbody>
</table>

Application Surface Conditions - Dry Surface Conditions - Wet

- **Ramp steeper than 1:14**
  - P4 or R11
  - P5 or R12

- **Ramp steeper than 1:20 but not steeper than 1:14**
  - P3 or R10
  - P4 or R11

- **Tread or landing surface**
  - P3 or R10
  - P4 or R11

- **Nosing or landing edge strip**
  - P3
  - P4
PERMEABLE PAVING

*system overview*

1. **Causeway Permeable Pavers** feature a unique edge chamfer and bevel which permits butt joining. A light dressing of 3mm diameter clean aggregate should be applied during compaction.

   *For available paver sizes and paver colours, please contact 02 9840 2333.

2. **Bedding Course** 50mm thick layer of 5mm single size crushed aggregate.

3. **Fabric Filter (Optional)** Geotextile, standard or heavy grade depending on pavement design.

4. **Sub-base** Typically 350mm thick layer of single size 40mm crushed aggregate, gap graded, and yielding 30% voids. Thickness may be varied depending on pavement design.

5. **Perimeter Membrane** Either impermeable plastic membrane for tanked systems, or permeable Geotextile for infiltration systems.
PERMEABLE PAVING

system components

1. A surfacing of permeable pavers design to permit the rapid infiltration of rainfall. Typically, the pavers will be 80 mm thick.

2. The joints between the pavers must not be left empty but should be completely filled with a uniform aggregate of 3mm thickness. Sand must not be used instead of aggregate as it slows water ingress.

3. Depending on the degree of infiltration that can be achieved for a particular design, it may be necessary to provide drainage at the perimeter of the paving to manage overflows. This can be achieved by using conventional gulley inlets to existing storm sewers or by constructing swales or bio-retention areas adjacent to the pavement.

4. The permeable pavers are laid on a 20-40 mm bedding course of uniform aggregate typically 5 mm in size. Sand is not suitable as a bedding course and should not be used in permeable pavements because it does not allow water to infiltrate rapidly enough to cope with Australian rainfall.

5. Beneath the bedding layer a permeable geotextile may be installed. This is optional and is only used when it is desired to mobilise biological controls of hydrocarbons etc.

6. A permeable base course normally consisting of a 250mm deep compacted unbound layer. This layer is composed of granular materials at larger size at the bottom, medium size in the middle and smaller sized granular material at the top. These varied layers of granular material allow water of 63 - 10mm granular materials or to engineers specifications. This provides the main load-bearing layer. The thickness of this layer must be sufficient both to resist traffic loads and to provide adequate water storage.

7. On cohesive sub grades, a filter fabric must be provided under the base course to prevent clay migrating into the pavement. This is not needed where the sub grade is granular i.e a sandy or gravelly material.

8. Where the sub grade is contaminated, saline or expansive, an impermeable membrane must be provided under the base course to prevent water entering or leaving the pavement. This membrane will normally be run up the sides of the pavements.

9. The in-situ soil at the pavement site is known as the sub-grade. The type of sub-grade determines what type of permeable pavement cross-section is feasible and how thick the pavement will need to be to resist traffic and to control stormwater. The sub-grade must always be compacted to a depth of at least 100 mm.
PERMEABLE PAVING

infiltration system

Typical infiltration system design

Water is allowed to drain between pavers with some filtration through sub base materials before entering naturally occurring ground water systems.

An infiltration system is only suitable when the run off dispersed over the paved surface is unlikely to carry contaminants that could leach into the ground water system and cause further issues. Generally sites where automotive or industrial activities are to take place will have contaminants present and require further assessment prior to an infiltration system being employed.
PERMEABLE PAVING

Tanked system

Typical tanked system design

Water drains between pavers with some filtration through sub base materials before being captured by impermeable membrane and directed to a pvc pipe for storage/use.

Typical tanked systems

Infiltration and overflow

Typical and re-use

Tanked with additional treatment

Tanked water will be partially filtered through sub base materials however the requirement for further filtration should be determined and suitability for further reuse assessed, based on local site conditions and contaminants present, in addition to the reuse application. Further filtration may be required for various reuse applications.
PERMEABLE PAVING

design considerations

Overview

Things to consider when selecting a paving system include traffic type (vehicle or pedestrian) and frequency, existing soil type, location, aesthetic preference and cost. Before installing porous paving in a driveway, path or patio area, you need to decide which type to install – loose gravel, structural gravel or grass, masonry pavers or engineered pavers.

Location

If the paved area slopes towards the house, a pit or strip drain connected to existing stormwater may be required to remove excess water during heavy rainfall. However, paths and driveways with a gradient greater than 5% (1:20) may not be suitable for permeable paving.

Traffic type

Permeable pavement should be used for low volume parking and roads with light vehicle use. Sites with heavy vehicle use require further engineering to ensure contaminants are effectively captured.

Soil type

Permeable paving is most effective when installed in sandy areas where rainwater can easily drain away from the soil. If you are planning to install permeable paving in an area with heavy clay soil or poor drainage, additional sub surface drainage may be needed.

Underground services

Be aware of any underground services (gas, electricity, water) before excavating the pavement area. Permeable paving should not be built over or in close proximity to a septic system.
Infiltration Rates

The required infiltration capacity of a soil surface, vegetated area or pervious pavement for a selected design storm event (with zero overflow) is calculated by:

\[ Q_{\text{peak}} = k_h A_{\text{inf}} \]

Where \( Q_{\text{peak}} \) = peak design runoff rate from the contributing catchment (m\(^3\)/s)

\( k_h \) = design hydraulic conductivity (m/s)

\( A_{\text{inf}} \) = surface area available for infiltration (m\(^2\))

\[ \text{Hence} \quad \frac{C \cdot i \cdot A}{1000 \times 60^2} = k_h A_{\text{inf}} \]

Where \( C \) = runoff coefficient as defined in Institution of Engineers Australia (2001)

\( i \) = probabilistic rainfall intensity (mm/hr)

\( A \) = total defined catchment area (m\(^2\)), i.e. the area of the treatment surface plus the surrounding contributing catchment area

This equation applies where the infiltration surface is located within the total defined catchment area (A), as shown in Figure 4, the paving is uniformly porous and the overall value of the hydraulic conductivity for the product and its underlying substructure is known. However, for permeable paving where part of the pavement area is impervious and this has not been accounted for in the overall value of the hydraulic conductivity, a blockage factor must be applied. The blockage factor accounts for the surface area of the pavement that is not contributing to infiltration.

\[ \text{Hence:} \quad \frac{C \cdot i \cdot A}{1000 \times 60^2} = k_h (1 - \Psi) A_{\text{inf}} \]

Where: \( \Psi \) = infiltration surface blockage factor
PERMEABLE PAVING

installation

Laying permeable pavers

Generally permeable paving systems are laid in a 90° herringbone pattern but you can use other patterns as required. Just be sure to consult your pavior and storm water engineer before deciding on a pattern for your project.

It is recommended to have a single header course or double stretcher course of pavers around the perimeter of the paved areas and also at the edges of any separately restrained areas such as tree pits. It is strongly recommended that pavers are taken from at least 2 or 3 packs and mixed during laying to minimise noticeable colour variations.

Where pavers need cutting they should not be cut smaller than 30% of the paver size and all cutting should be carried out using a disc cutter. Occupational health and safety requirements should be observed at all times.

Compaction

After they are laid the pavers should be vibrated with a high-frequency, low amplitude vibrating plate compactor. The use of carpet or something similar will help prevent marking the paver surface. Following the first pass with a vibrating plate, spread the light dressing of 3mm single size clean stone at the rate of approximately 1-2kg/m² over the surface and brush into the joints. The pavers should be vibrated once again and remaining debris brushed off.
MAINTENANCE
of permeable pavers

Overview

Maintenance of permeable pavement systems requires regular inspection and cleaning to maintain porosity, repair of potholes and cracks and replacement of clogged areas.

Regular vacuum sweeping can improve the efficiency of the system. It is recommended that cleaning be undertaken every 3 months. Overseas experience in the use of permeable paving has shown that complete clogging can occur between five and ten years after installation, so cleaning of the paving is essential.

Occasional light power cleaning may be used to remove unsightly surface contaminants.

Under normal conditions and appropriate light maintenance cycles as detailed above, a working life of 25 years can be expected. After this time, the pavers can be lifted and cleaned, the bedding materials and filter fabrics replaced, and the pavers re-laid to continue providing excellent service into the future.

Efflorescence

Efflorescence is a powdery deposit of salts (usually white or yellow) and is often found on the surface of concrete pavers after a period of rain. Efflorescence appears due to external sources from surrounding materials. For example, salty soils or fertilisers draw up through the pavers by the drying effect.

Prior to laying your pavers, make sure a clean bedding layer of 5mm granular material is the foundation of the paving – this will form a barrier to salts migrating to the pavers from below. Efflorescence can be removed by using either a dry brushing technique or wiping with a damp cloth making sure the salts are carried away from the pavers.

Organic Growths – Fungus, Mould and Moss

Porous masonry may provide an environment for organic growth when it is continuously moist, especially in light but shady conditions and when there are plenty of nutrients available.

Clean off the growth as much as possible with a dry bristle brush. Organic growths should be treated with liquid chlorine, or common household chemicals such as Exitmould and White King or a proprietary weed killer. The solution should be left for several days and then brushed off with hot water and detergent.
A number of pavers are cracked/faulty

The most common causes of cracked pavers are heavy impact or damage. Pavers are cured prior to delivery so there is minimal shrinkage or contraction of the material. Because there are several small units making up the pavement, with jointing sand in between, a segmental concrete pavement is unlikely to crack due to minor ground movement.

The faulty pavers are removed and replaced with new pavers

The faulty pavers can be pulled up from the existing pavement and disposed of. The area where they are taken from should be rebedded and new pavers installed to complement the existing pavement.

The hardstand is restored to its original strength and condition

After remediation, the hardstand is restored to its original strength. Use of a new product does not negatively impact the existing pavers.
REMEDIATION
of concrete pavements/slabs

A crack appears in one area of the pavement
The most common causes for cracking in concrete pavements/slabs is ground movement, shrinking or contraction of the material for various reasons, or impact/damage.

The cracked area is cut out and replaced
When a section of concrete pavement cracks, applying an adhesive to seal the crack merely hides the issue as the crack is likely to spread from this point. For this reason the cracked concrete section is generally removed by jackhammering in a square or rectangular segment and then a new section poured and doweled into the existing hardstand.

At the corner where the concrete has been cut, a weak point is created
When a section of the concrete pavement is removed and a new section laid, the two sections have different properties (they don’t create one solid unit). The corner section where the concrete is cut has higher likelihood of cracking than other sections of the hardstand because it creates a ‘fissure point’.
Brickworks Building Products is one of Australia’s largest and most diverse building material manufacturers. Under the Brickworks Building Products umbrella are some of Australia’s best known building materials brands. Our products include bricks, pavers, masonry blocks, retaining wall systems, precast concrete panels, concrete and terracotta roof tiles, timber products and specialised façade systems.

With a broad product portfolio and manufacturing and sales facilities across Australia, Brickworks Building Products is uniquely placed to service the demands of the building industry.

With over 1200 staff across Australia and New Zealand, we pride ourselves on our commitment to product, service excellence and our leadership position.
1. **Stock colours.** Colours other than stock colours are made to order. Contact your nearest Austral Masonry office for your area’s stock colours. A surcharge applies to orders less than the set minimum quantity.

2. **Colour and texture variation.** The supply of raw materials can vary over time. In addition, variation can occur between product types and production batches.

3. **We reserve the right to change the details in this publication without notice.**

4. **Terms & Conditions of Sale** please contact your nearest Austral Masonry sales office.

5. **Important Notice.** Please consult with your local council for design regulations prior to the construction of your wall. Councils in general require those walls over 0.5m in height and/or where there is loading such as a car or house near the wall be designed and certified by a suitably qualified engineer.

6. **Max wall heights disclaimer.** The gravity wall heights are maximum heights calculated in accordance with CMAA MA-25 Appendix D guidelines and a qualified engineer should confirm the suitability of the product for each application. As such, due consideration must be given to but not limited to: Cohesion, dry backfill, no ingress of any water into the soil behind the retaining wall. All retaining walls are designed for zero surcharge unless noted otherwise. These walls are intended for structure Classification A walls only as defined in AS4978 Earth Retaining Structures as being where failure would result in minimal damage and/or loss of access. The product images shown in this brochure give a general indication of product colour for your preliminary selection. Austral Masonry recommends all customers see actual product samples at a selection centre prior to making final selections.