domestic design guide
responsible rainwater management around the home

version 4

Interpave
THE PRECAST CONCRETE PAVING AND KERB ASSOCIATION
www.paving.org.uk
Introduction

When you are planning a new drive, patio or path for your garden, you probably don't think about where the rainwater landing on it will end up. But taking a responsible approach to drainage is important to help in the fight against flooding and pollution – and also to meet new rules, which could otherwise result in action by your local authority or make selling your home more difficult.

Interpave’s ‘Paving for Rain’ document – which you can download from www.paving.org.uk – explains all these issues and the latest rules in more detail. It provides essential guidance for planners, surveyors, conveyancing lawyers, designers, landscapers and contractors, as well as homeowners.

How to use this Design Guide

This document aims to provide straightforward, practical guidance for homeowners, designers and contractors, based on design calculations using sound engineering principles. It helps you choose the right type of paving drainage system with design guidance for each type.

We strongly recommend that you engage an Interlay member contractor to install all types of precast concrete paving – visit www.interlay.org.uk – or a contractor registered with an Interpave manufacturer member’s approved scheme – visit www.paving.org.uk to link to members’ websites. This Design Guide also includes construction information and our maintenance advice will help you keep your finished paving and garden in good condition for years to come. Finally, a list of Definitions (at the end of this Guide) will help you understand some of the terms used.

This guide only applies to the design and installation of private driveways, patios and other lightly trafficked paving around the home. For other applications, fully engineered solutions are available via the Commercial section of www.paving.org.uk. The Interpave website also contains extensive detailed information for construction professionals on all types of precast concrete paving.
How to achieve sustainable drainage around your home

This section provides step-by-step guidance on the design of sustainable paving for driveways and other larger (over 18m²) paved areas around the home, based on calculations using sound engineering principles. Generally, smaller areas and long, narrow paths can simply be drained onto adjacent garden areas with falls away from the house – although care should be taken not to affect neighbouring properties. However, if the existing ground (before you start work) tends to become waterlogged during rain, additional drainage measures may be needed.

Building Regulations

Paved areas and drainage associated with new buildings and extensions will probably be subject to The Building Regulations (or Building Standards in Scotland) and need to be checked with your local authority – although just laying paving around your home does not. Sustainable drainage – as dealt with in this guide - is encouraged by the Regulations and infiltration of water into the ground the preferred option wherever possible.

The Regulations are concerned about the possible effects of infiltration close to buildings. So, they require soakaways and other devices handling a lot of water to be at least 5m away. Your local authority might also apply this to rain gardens or infiltrating permeable paving handling water from elsewhere – but not to permeable paving just draining itself. In some parts of the country there are problematic ground conditions where infiltration could adversely affect foundations to houses. If in doubt seek advice from a specialist or the local authority building control department. For rain gardens and permeable pavements, the ‘5m rule’ should apply to any size drive where roof water runs onto the drive from the downpipe. If the site has had a previous use before housing was constructed (known as a ‘brownfield site’), or the site is on a very steep hillside or there is a history of instability in the area (e.g. sink holes), seek specialist advice. The following guidance includes this ‘5m rule’, although local conditions might justify reducing or removing it.

Potential Systems

Using conventional concrete block paving

1. to rain garden with infiltration to the ground

2. to rain garden with trench infiltration to the ground

3. to rain garden with trench and pipe to drain or water harvesting
Using concrete block permeable paving – with infiltration to the ground

Selecting a suitable system

Responsible water management from paving around your home can be achieved with either conventional concrete block or slab paving to rain gardens, or with concrete block permeable paving. There are five systems recommended, listed in order and starting with what is likely to be the most cost-effective and straightforward to construct:

A few simple steps will enable you to select the best system for your home:

**Step 1** What systems suit the topography? How big is the front garden; is there space to the side for rear access; which way do the gardens slope? The Flow Chart on page four will identify possible systems.

**Step 2** What is the soil permeability? How long does water take to drain away with a simple trial? The Table on page five will identify which Systems selected in Step 1 are possible.

**Step 3** What potential systems are available for the soil type?

**Step 4** What else should I consider to refine my choice? From the alternatives resulting from Steps 1 – 3, consider the characteristics of each system to select the best for your needs. The System Detail pages from page six onwards will provide information on each.
Step 1 – What systems suit the topography?

Look around your garden. A simple assessment of the topography around your home will help you identify from the flow chart which systems might be suitable.
Step 2 – What is the soil permeability?

A simple test on site. Choosing the most appropriate system also depends upon the type of soil around your home and its ability for water to drain through (known as permeability), which can be estimated using this simple test:

1. Dig a hole at the location of the permeable pavement or rain garden. The bottom of the hole should be at the same level that water will drain out of the system into the ground and should be in the same soils that will accept most of the water. Avoid locating the hole in any areas that are not truly representative of general conditions in your garden. Beware of gravel or other material which could have been buried when your house was built. The hole should be 300mm x 300mm, by 300mm deep.

2. Fill the hole with water and allow it to drain away (this may take several hours), to soak the area.

3. Fill the hole with water again and record the time it takes for the water to drain away on this occasion.

4. Read off the Soil Permeability for the time taken:

<table>
<thead>
<tr>
<th>Time to drain</th>
<th>Permeability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 30 seconds</td>
<td>Excellent</td>
</tr>
<tr>
<td>Between 30 seconds and 13 minutes</td>
<td>Good</td>
</tr>
<tr>
<td>Between 13 minutes and 11 hours</td>
<td>Fair</td>
</tr>
<tr>
<td>Greater than 11 hours</td>
<td>Poor</td>
</tr>
</tbody>
</table>

Step 3. What potential systems are available for the soil type?

The next step is to find the system options available, only from those you identified in Step 1, for the soil type in your garden from the following table:

<table>
<thead>
<tr>
<th>Potential driveway drainage systems</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permeability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>✓</td>
<td>?</td>
<td>?</td>
<td>✓</td>
<td>?</td>
</tr>
<tr>
<td>Good</td>
<td>X</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
<td>?</td>
</tr>
<tr>
<td>Fair</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
</tr>
<tr>
<td>Poor</td>
<td>X</td>
<td>X</td>
<td>✓</td>
<td>X</td>
<td>✓</td>
</tr>
</tbody>
</table>

✓ OK

? Use only if other constraints prevent infiltration (eg adjacent slopes)

X Not suitable

Step 4 – What else should I consider to refine my choice?

Consider the alternatives.

You should now have a shortlist from Steps 1 – 3 giving one or more systems that are generally suitable for your garden. Now consider each of these systems in more detail on the following pages to choose the best for you, taking particular note of the other rules which apply.
Rain gardens and conventional concrete block paving systems

In its simplest form, a rain garden is a depression in the ground, with a surface overflow, to temporarily store water before it soaks into the ground or evaporates. It can include water-tolerant plants. A typical layout is shown below with sizes calculated for each rain garden system. Check that the systems appropriate for your garden comply with the rules shown on this page.

Drawing Notes

1. Conventional block paving sloping away from the building and towards channels.
2. Dished channel units laid to falls to collect water into rain garden and avoid runoff onto the road.
3. Rain garden shallow depression covered with decorative stone aggregate or plants (see pages ten – eleven for system details).
4. There must not be any steep drops to adjacent properties close to system 1 or 2 rain gardens.
5. The minimum distance between rain gardens and buildings is shown opposite:

Rain garden sizes

Sizes of the rain garden can be adjusted to suit the depth and size of garden available.

The following areas have been calculated for all three systems to handle runoff from:
- A double driveway (of about 38m²) – use a rain garden with a minimum area of 4m²
- A single driveway (of about 19m²) – use a rain garden with a minimum area of 2m²

Depths of rain garden are shown on pages ten – eleven.

<table>
<thead>
<tr>
<th>System:</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>For Single Driveway</td>
<td>3m</td>
<td>3m</td>
<td>2m</td>
</tr>
<tr>
<td>For Double Driveway</td>
<td>5m</td>
<td>5m</td>
<td>3m</td>
</tr>
</tbody>
</table>

The 5m rule should apply to any size drive where roof water runs onto the drive from the downpipe or where unusual ground conditions (as discussed on pages ten – eleven) might apply.

6. Normally, driveway and garden must slope away from the house towards the road.

For system 3 the slope should not be more than 1:10.

7. As with other drainage measures, rain gardens should have an emergency overflow route away from or around the house.
Concrete block permeable paving systems

1. Conventional block paving sloping away from the building and towards permeable paving.
2. Permeable paving driveway. Both systems can be used right up to the building (unless roof water is collected as well with system 4). The 5m rule should apply to any size of permeable paving drive where roof water runs onto the drive from the downpipe.
3. Optional infiltration area beneath garden, if needed, for either system. This can also help with irrigation.
4. Infiltration areas must be at least 3m (for a single drive) or 5m (for a double drive) away from building foundations.
5. Normally, driveway and garden must slope away from the house towards the road. A slight slope towards the house (up to 1:25) is acceptable with a dished channel at the bottom connected to the rainwater drain.
6. For system 4 there must not be any steep drops to adjacent properties within a distance from the driveway equal to the height of the drop. Neither system should slope towards neighbouring properties.
7. As with other drainage measures, rain gardens should have an emergency overflow route away from or around the house.

A typical layout is shown below for either system of permeable paving. Check that the systems appropriate for your garden comply with the rules shown on this page.
An example of Selecting the Best System

The following example shows you how to work through each step shown on previous pages. Let’s assume that a single driveway is proposed for a detached house where the 7m long front garden slopes gently away from the house towards the road:

Step 1

The flow chart shows that all five systems are possible at this stage.

Step 2

Let’s say the site test shows that it took 4 hours for the water to soak away, then the Soil Permeability is ‘Fair’.

Step 3

Although Step 1 showed all five systems were possible, the Soil Permeability now reduces the choice to Systems 2, 3, 4.

Step 4

System 2 is likely to be most cost effective and further details can be checked on the drawing and notes on page six. From this, the minimum area of rain garden should be 4m² and a dished channel is needed to direct water into the rain garden.

The Next Step

By working through these four Steps you should have determined the most suitable sustainable paving drainage systems for your home. The next step is to design and carry out the construction with the help of the following pages and other guidance on the Interpave website www.paving.org.uk. We strongly recommend that you consult an Interlay member contractor to install all types of precast concrete paving – visit www.interlay.org.uk.
Construction of sustainable paving and drainage around your home

The following pages give construction designs and advice for conventional concrete block paving, rain gardens and concrete block permeable paving. Advice on installing decorative concrete paving slabs, dished channels and other products can be found on the Interpave website www.paving.org.uk or from manufacturer members of Interpave.

For conventional or permeable block paving, an estimate of soil strength is needed based on simple tests according to whether your soil is clay or sand/gravel. Use the soil strength for your garden from the table to select the correct paving construction.

Determining soil strength

<table>
<thead>
<tr>
<th>Soil strength</th>
<th>Good</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay</td>
<td>Stiff – cannot be moulded by fingers and thumb cannot make surface</td>
<td>Firm – can be moulded by fingers and thumb can easily be pushed in impression on to make a surface impression</td>
</tr>
<tr>
<td>Sand or gravel</td>
<td>Compact – a 50mm square peg is hard to drive into the soil with a 1.8kg hammer</td>
<td>Loose – a 50mm square peg is driven into the soil easily with one or two hammer blows from a 1.8kg hammer</td>
</tr>
</tbody>
</table>

Conventional block paving – Construction for Systems

Select one of the two construction designs below according to soil strength. Guidance on construction can also be found at: www.paving.org.uk/commercial/cbp/bc.htm

Drawing Notes

1. Conventional block paving (usually 50mm).
2. Sand laying course (30mm) and joint filling.
3. ‘Type 1’ crushed stone sub-base, see table for thickness.
4. Existing soil which is compacted.
5. Geotextile (see page fifteen).

The above guidance applies to driveways for car traffic only. For heavier traffic such as removal lorries, refer to the Interpave website www.paving.org.uk

<table>
<thead>
<tr>
<th>Soil strength</th>
<th>Good</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-base thickness</td>
<td>150mm</td>
<td>200mm</td>
</tr>
</tbody>
</table>
Rain gardens – construction of Systems 1 2 3

Construction designs for the three alternative rain garden systems are shown here. Each system can be finished with either plants or decorative stone, or a mixture of both. Normal border plants that can cope with 1 or 2 days standing in water are generally suitable: your local garden centre can advise.
Drawing Notes

1. Plants in 60/40 rootzone material or mulch (100mm deep) or
2. Decorative stone finish (for example, 25-75mm cobbles or slate pieces).
3. Shallow depression within rain garden (100mm).
4. Trench below filled with 10mm pea gravel – not limestone gravel – (400mm deep).
5. Geotextile (see page fifteen) wrapped over pea gravel/under rootzone material or 150mm below decorative stone finish.
6. Depression within rain garden (200mm).
7. Trench below filled with 10mm pea gravel – not limestone gravel – (500mm deep).
8. 100mm diameter perforated pipe to collect water, connected to roof water drain or sewer.
9. Membrane liner to contain water, below and up the sides of the construction.
Concrete block permeable paving – Construction for Systems

The three steps on earlier pages should have identified which of the two systems shown below is most suitable for your garden.

Guidance on construction can also be found at: www.paving.org.uk

Drawing Notes

1. Concrete block permeable paving (usually 80mm).
2. Grit (2–6mm) laying course (50mm) and joint filling.
3. Permeable crushed stone sub-base (see next page for thicknesses).
4. Geotextile (see page fifteen).
5. Existing sub-soil which is compacted.
6. With system 4 water gradually passes through to the ground.
7. With system 5 water is carried away by a plastic fin-drain connected to roof water drain or an infiltration area. Fin-drains could also be used with system 4 as an overflow.
8. Membrane liner to contain water, below and up the sides of the construction.

Landscaped areas should not be sloped towards concrete block permeable paving if possible. If it cannot be avoided, a strip of flat gravel or turf should be provided between the landscaping and the paving to catch any soil that is washed off. This is to prevent the soil clogging the spaces between the blocks.

Sub-base Thickness

For both permeable paving systems, the thickness of sub-base needed for a driveway depends on two things:

- The rainfall levels expected in your area. This is summarised on the map below from which you can select which of the two areas you live in.
- The strength of the soil in your garden. This can be estimated from the simple tests on page nine.

See page thirteen for thicknesses
The sub-base thickness should be sufficient to create a firm working platform and to ensure that the ground remains stable when trafficked by construction plant. The work should be undertaken by a skilled groundworks contractor with experience in evaluating the sub-base thickness required. If system 4 is used on clay soils the soil should be assumed to have poor strength.

The above guidance applies to driveways for car traffic only. For heavier traffic such as large 4 x 4s and removal lorries, refer to the Interpave website www.paving.org.uk

<table>
<thead>
<tr>
<th>Soil strength (see page nine)</th>
<th>Good</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area from map:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetter</td>
<td>250mm</td>
<td>500mm</td>
</tr>
<tr>
<td>Drier</td>
<td>200mm</td>
<td>450mm</td>
</tr>
</tbody>
</table>
Combined systems and water harvesting

On the previous pages we have looked at five different sustainable paving drainage systems but there may be good reasons to combine different techniques, if they are suitable for your particular situation.

They can also be used to store water for irrigation of gardens by pumping out or using infiltration areas where irrigation is needed. It is best to obtain expert help to design these systems as they may require pumps and the storage design is more complicated.

Maintaining sustainable paving drainage systems

Rain Gardens

A rain garden is an extremely reliable and easy-to-look-after means of drainage but simple precautions should be taken with both the garden and paving sloping onto it.

Do…

- keep it clear of litter

Don’t…

- let wet concrete run on it as this will block it
- store things in the rain garden as this will stop it working
- pour oil or other chemicals (eg weed killers) over it as this could contaminate groundwater.

Concrete block permeable paving

A concrete block permeable pavement is a very robust drainage system and requires little maintenance, apart from the following.

Do…

- keep it well swept

Don’t…

- mix concrete on it as this will block it
- put piles of soil on it as this will block it
- pour oil or other chemicals (eg weed killers) over it as this could contaminate groundwater.

www.paving.org.uk – the paving resource
Definitions of terms

Sub-base aggregate (for conventional concrete block paving) – A dense mixture of sand and gravel compacted to give a hard surface on which to build the driveway. Often referred to as DOT ‘Type 1’ material.

Type 1 Material – see above.

Permeable pavement sub-base aggregate – Crushed rock or similar material that does not have sand in the spaces between the rock pieces. This allows water to flow easily through it. One sort of aggregate is known as DOT ‘Type 3’ material.

Permeable Material – see above.

Attenuation – Slowing the flow of rainwater from hard surfaces down so it can enter the drains more slowly, as it would from grassed areas.

Permeability – A measure of how fast water can flow through the ground.

Water table level – The level at the top of the water in the ground. If a hole is dug in the ground that goes below the water table it is the level of standing water in the hole after it has stabilised.

Conventional concrete block paving and flags – Block paving and slabs that do not allow water to soak through them into the sub-base.

Concrete block permeable paving – Strictly speaking, this is the surface of block paving with special gaps between each block that allows water to soak into the sub-base. Sometimes it also describes a concrete block permeable pavement – The whole construction including the concrete block permeable paving, laying course and the layer of permeable pavement sub-base aggregate.

Laying course material – A layer of fine material that is placed over the sub-base to make it easier to lay the blocks to the required levels and falls. For Conventional concrete block paving and flags this is sand. For Concrete block permeable paving it must allow water to flow through it easily and so a fine grit sized aggregate is used.

Membrane Liner – A plastic sheet that is water tight. It should be 0.5mm thick (2000 gauge).

Sewer – A pipe in the ground that collects water and removes it from a site. Older sewers remove sewage (known as foul water) as well as rainwater and are known as combined sewers. New developments have separate sewers for foul and rainwater.

Drain – Common name for smaller sewers that are located within the boundary of a house. Connect into main sewers that are usually (but not always) in the street.

Conventional drainage system – The network of sewers below an area, including private drains, main sewers and ancillary structures such as manholes and gullies.

Dished channel – U-shaped precast concrete units available from Interpave members in a range of colours which can match the paving if desired.

Fin Drain – A flat drainage system which channels water through a filter into a drainage core before it enters a drainage pipe, thereby reducing the likelihood of the pipe becoming blocked with silt. Fin drains take up little room and work efficiently.

Geotextile – A fabric, made of plastic fibres, that is permeable to water but stops soil being washed through.
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