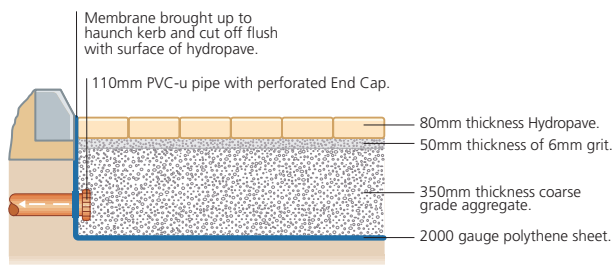


technical information v1.0

What types of systems are available?

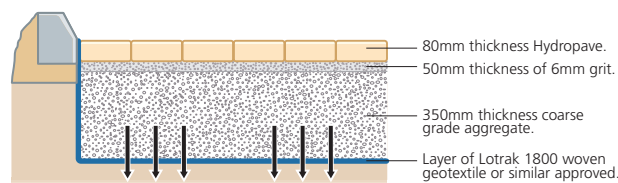
There are two common types of permeable paving systems, Attenuation and Infiltration.

Typical Attenuation System



The Attenuation system temporarily stores the water in the crushed stone beneath the paving before being slowly released back into the drainage systems. This therefore reduces the peak downstream flow from a result of heavy rainfall.

Typical Infiltration System





The Infiltration system allows the water to flow slowly through the crushed stone beneath the paving before being slowly released back into the ground through a geotextile.

What system should I use?

Tobermore have an external design team that can provide design advice for your permeable paving project. Simply contact one of our sales executives who can provide assistance and guidance on how this works.

What are the key components of a permeable paving system?

The key components of the system is the sub-base, the bedding layer, the paving blocks and the jointing grit. As long as the system has been adequately designed for the site the most important next step is to get these components right.

Sub-base	A clean 20-5mm coarse graded aggregate to BS7533-13:2009 must be used for this component. A crushed rock angular stone works best.*	
Bedding layer	The blocks are laid on a 6.3-2mm grit to BS7533-13:2009.*	
Paving blocks	Tobermore have a wide range of Hydropave blocks available and they have a permeability of 1800 litres/sec/hectare which more than meets the 180 litres/sec/hectare requirement.	
Jointing grit	The blocks are jointed using a 6.3-2mm grit to BS7533-13:2009.	

* Must be compatible.

design

How do I design a permeable paving system?

Tobermore have an external design team that can provide design advice for your permeable paving project. Simply contact one of our sales executives who can provide assistance and guidance on how this works. Alternatively you can refer to the following source of information BS7533-13:2009 Pavements constructed with clay, natural stone or concrete pavers. Guide for the structural design of permeable pavements.

What if the ground is poor or there will be significant vehicles on the paving?

Various improvement layers can be installed below the permeable paving to ensure the system can meet the structural load on the project. The engineer on the project will design these into it based on the loading category required. The two most common types of improvement layers are **Dense Bitumen Macadam (DBM)** and **Cement Stabilised Coarse Graded Aggregate (CSCGA)**.

Specifications for Dense Bitumen Macadam and Cement Stabilised Coarse Graded Aggregate can be found in the Interpave guide. Method statements on how to install these layers can be supplied on request.

What is the ratio required of permeable area (Hydropave) to impermeable to areas (roads, roofs etc)?

Sometimes, water from building roofs or nearby impermeable areas is fed into permeable paving. It is best to do this only in the case of attenuation systems when a typical ratio of 2:1 can be used between impermeable and permeable zones.

Do we provide a design guarantee?

Our design consultant can provide design guidance. This can be supported by their Professional Indemnity insurance. It does not provide a warranty but indemnifies him against a claim for

professional incompetence. This is similar to the level of insurance for all civil and structural engineering projects.

Contract clause

From our experience we think it is essential that the engineer for the project should include the following form of words as part of the construction contract and placed on the permeable paving drawing:

A permeable paving design relies heavily on using the correct aggregates. Prior to installation, we would ask you to test both the 20-5mm coarse graded aggregate and also the 6.3-2mm bedding and jointing grit as per the relevant British Standard specification (BS7533-13:2009). In our experience, incorrect use of aggregates is one of the most common reasons for failure of a permeable paving design.

When the scheme is nearing completion, we would recommend that all the joints in the paving are filled to the top with the 6.3-2mm jointing grit. Joints that are not properly filled could lead to possible movement in the bricks at a later date.

Finally, we would suggest that, after the area has been 'trafficked' for a short period of time (say, approximately 2-3 months), a site inspection is carried out on the joints to ensure they remain full. On occasions, a joint may appear full at the outset, but need topped up after initial trafficking due to settlement in the jointing material.

Care should be taken that the permeable joints do not become contaminated as work on the scheme is completed. Special care needs to be taken when soft landscaping is carried out so that over spilt soil does not enter the joints.

installation

How to install a permeable paving system

Please refer to the following sources of information - BS 7533-3:2005 Pavements constructed with clay, natural stone or concrete pavers. Part 3: Code of practice for laying precast concrete paving blocks and clay pavers for flexible pavements.

Do you compact the 20-5mm aggregate?

Because the material has no fines, it does not need to be compacted in the usual way. However, its particles need to be re-oriented to ensure that they occupy the least volume - if this is not undertaken during construction, it will occur under traffic leading to pavement unevenness. Do this with either a tandem roller or a plate vibrator. Whichever is used, allow only sufficient vibration to re-orientate the particles which should be a small part of the vibration available.

Do you plate vibrate the blocks before the joints have been filled with 6.3-2mm grit?

Yes, install the pavers in the chosen pattern and undertake two passes of the plate vibrator. Then brush the grit into the joints until they are completely filled. Brush away any loose grit before undertaking a final pass with the plate vibrator. This is the "pre-compaction" alternative described in BS7533-3:2005.

Do you plate vibrate the 6.3-2mm laying course material?

No, simply screed the 6.3-2mm laying course material over the 20-5mm.

Joint filling

The permeable paving joints should be filled to the top with 6.3-2mm grit. It is important to top up these joints after 2-3 months due to the settlement of the grit.

How much 6.3-2mm does it take to fill the joints?

You need approximately 1 ton of grit for every 100sqm of paving.

Can permeable pavements be laid in adverse weather conditions?

By the nature of this type of pavement, all laying operations can be undertaken in adverse weather conditions. It is essential that any soil, fine material and other materials that arise during construction should be prevented from contaminating the pavement surface to ensure the pavement remains permeable.

maintenance

How do you maintain a permeable paving system?

Please refer to the following sources of information – Guide to the design, construction and maintenance of concrete block permeable pavements Edition 5 produced by Interpave available for download on www.paving.org.uk

Do you have details on how to clean the joints of Hydropave?

As with all permeable paving, there is no necessity to undertake joint cleaning and we expect that for most permeable pavements, this will not be necessary. Hydropave can accommodate 1800 litres/second/hectare whereas the maximum intensity storm will generate 180 litres/sec/hectare. This means that the joints can become over 90% clogged and still operate satisfactorily. However, to be conservative, we recommend that you should expect to have to clean the joints every seven years. The procedure is as follows:

- 1 Remove existing jointing material by either high pressure water jet or high pressure steam. This will remove both the jointing grit and the detritus.
- 2 Undertake two passes of a plate vibrator to reset the pavers which will have become displaced by the blasting operation and also to re-compact the laying course material, ie. the bedding grit. The opportunity can be taken to replace any damaged pavers at this time since they will have been loosened.
- 3 Apply 6.3-2mm single size grit to the joints, using a stiff brush to sweep the material in.
- 4 Undertake a third pass of the plate vibrator.
- 5 Top up the grit.
- 6 It may be necessary to top up these joints after 3 months due to the settlement of the grit.
- 7 Special care needs to be taken when soft landscaping is carried out so that over spilt soil does not enter the joints.

catalogue of designs

Although a full engineering approach will be needed for virtually all pavements, Tobermore's experience suggests that the following standard solutions will be suitable in most circumstances and can therefore be used at project appraisal stage. Tobermore will be able to confirm their suitability for a specific project upon receipt of your detailed proposal.

Note:

In the case of attenuation designs, subgrade CBR values are equilibrium moisture content values.

In the case of infiltration designs, subgrade CBR values are soaked values.

Capping thickness may need to be adjusted upwards to achieve a firm working platform which can sustain loads from construction traffic without deforming excessively and which can offer sufficient reaction to allow the overlying materials to be fully compacted.

All pavements must meet the requirements of BS7533 Part 3 in terms of installation.

The thicknesses of coarse graded aggregate will be suitable for the traffic conditions shown and in the case of attenuation designs should be sufficiently thick to meet the attenuation requirements. However, a site specific hydraulic analysis should be carried out using the method set out in the Interpave Guidelines. In the case of infiltration designs, there is usually no need to check hydraulic capacity but a check must be made on the infiltration capacity of the ground. The ground must be proven to accept 20mm of water in one hour which will have to be scaled up if the pavement is infiltrating water draining towards it from impermeable paving or from downpipes.

Where traffic weights exceed those commonly encountered on public highways, specialised design advice should be sought. Contact the Tobermore Sales Office.

Where light vans are included, their maximum capacity is 15kN (300cwt).

Sub-base & Capping Layers

Capping thickness to be sufficient to provide a firm working platform or in the case of low CBR subgrades ground stabilisation may be more cost effective. If CBR is 5% or greater then capping layers are not required. It is advised that all sites need independent inspection and assessment by a suitably qualified engineer prior to project commencement.

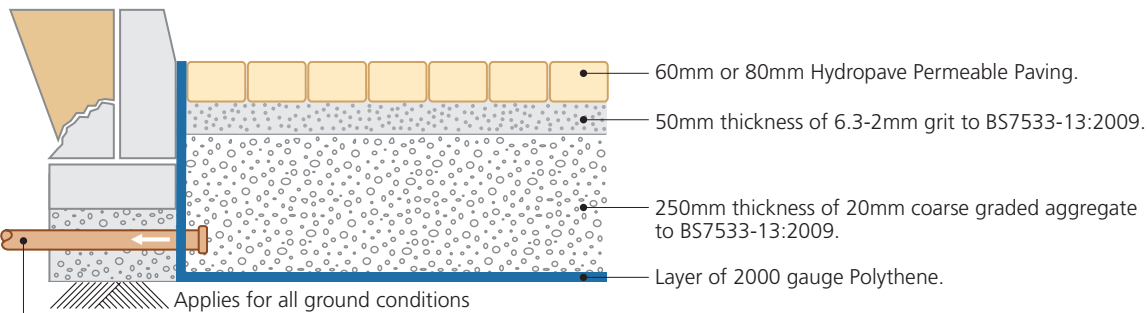
1 DOMESTIC	2 CAR PARKING	3 PEDESTRIAN	4 SHOPPING	5 COMMERCIAL	6 HEAVY TRAFFIC
No large goods vehicles	Emergency large goods vehicles only	One large goods vehicle per week	Ten large goods vehicles per week	100 large goods vehicles per week	1000 large goods vehicles per week
Zero standard axies	100 standard axies	0.015msa	0.15msa	1.5msa	15msa
Patio	Car parking bays and aisles	Town/city pedestrian street	Retail development delivery access route	Industrial premises	Main Road
Private drive	Railway station platform	Nursery access	School/college access road	Lightly trafficked public road	Distribution centre
Decorative feature	External car showroom	Parking area to residential development	Office block delivery route	Light industrial development	Bus station (bus every 5 minutes)
Enclosed playground	Sports stadium pedestrian route	Garden centre external display area	Deliveries to small residential development	Mixed retail/ industrial development	Motorway truck stop
Footway with zero vehicle overrun	Footway with occasional overrun	Cemetery Crematorium	Garden centre delivery route	Town square	Bus stop
	Private drive/ footway crossover	Motel parking	Fire station yard	Footway with regular overrun	Roundabout
		Airport car park with no bus pick-up	Airport car park with bus terminal	Airport landside roads	Bus lane
		Sports centre	Sports stadium access route/forecourt		
Dense Bitumen Macadam (DBM) alternative to cement stabilised coarse graded aggregate					
zero cement bound	zero cement bound	125mm cement bound	150mm cement bound	200mm cement bound CGA	300mm cement bound CGA
70mm DBM50	70mm DBM50	70mm DBM50	100mm DBM50	130mm DBM35	185mm DBM35

MSA = millions of standard 8,000kg axles

attenuation designs

LOADING CATEGORY 1 1-5%CBR

Conventional edge restraint



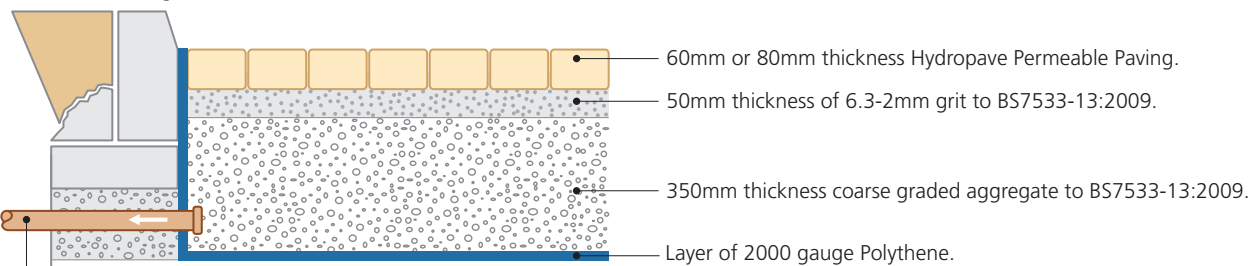
Sub-base & Capping Layers -

Capping thickness to be sufficient to provide a firm working platform or in the case of low CBR subgrade ground stabilisation may be more cost effective.

Outflow pipe - diameter according to project requirements (with perforated End Cap to prevent blockage of the pipe and a Top Hat Seal is used to achieve a water tight connection)

LOADING CATEGORY 2 1-5%CBR

Conventional edge restraint



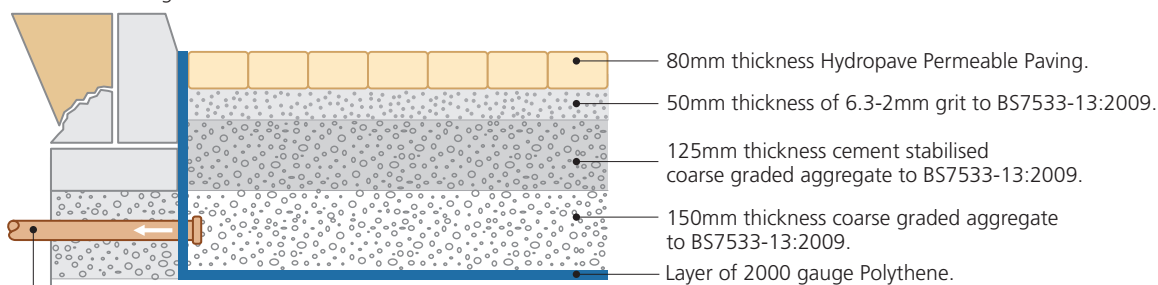
Sub-base & Capping Layers -

Capping thickness to be sufficient to provide a firm working platform or in the case of low CBR subgrade ground stabilisation may be more cost effective.

Outflow pipe - diameter according to project requirements (with perforated End Cap to prevent blockage of the pipe and a Top Hat Seal is used to achieve a water tight connection)

LOADING CATEGORY 3 1-5%CBR

Conventional edge restraint



Sub-base & Capping Layers -

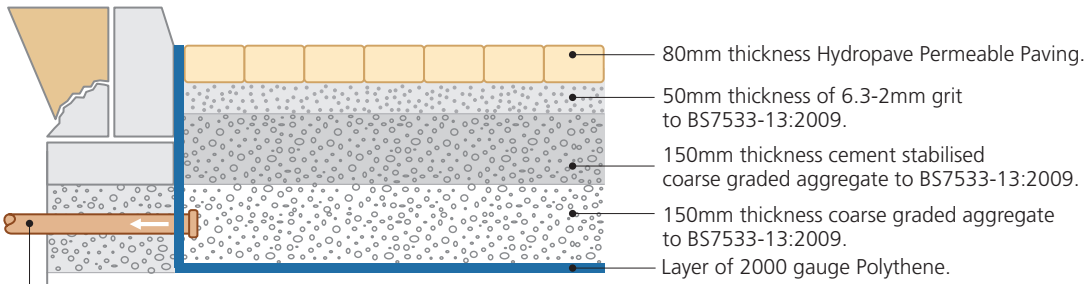
Capping thickness to be sufficient to provide a firm working platform or in the case of low CBR subgrade ground stabilisation may be more cost effective.

Outflow pipe - diameter according to project requirements (with perforated End Cap to prevent blockage of the pipe and a Top Hat Seal is used to achieve a water tight connection)

For DBM alternative please refer to table on page 3.

LOADING CATEGORY 4 1-5%CBR

Conventional edge restraint



For DBM alternative please refer to table on page 3.

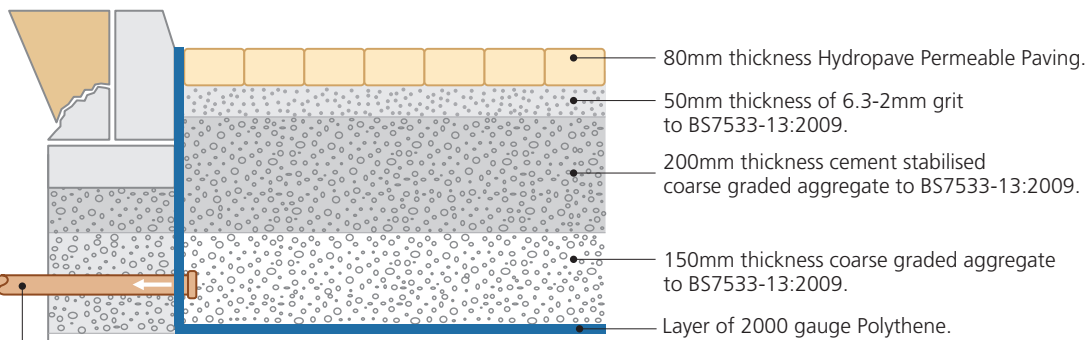
Sub-base & Capping Layers -

Capping thickness to be sufficient to provide a firm working platform or in the case of low CBR subgrade ground stabilisation may be more cost effective.

Outflow pipe - diameter according to project requirements (with perforated End Cap to prevent blockage of the pipe and a Top Hat Seal is used to achieve a water tight connection)

LOADING CATEGORY 5 1-5%CBR

Conventional edge restraint



For DBM alternative please refer to table on page 3.

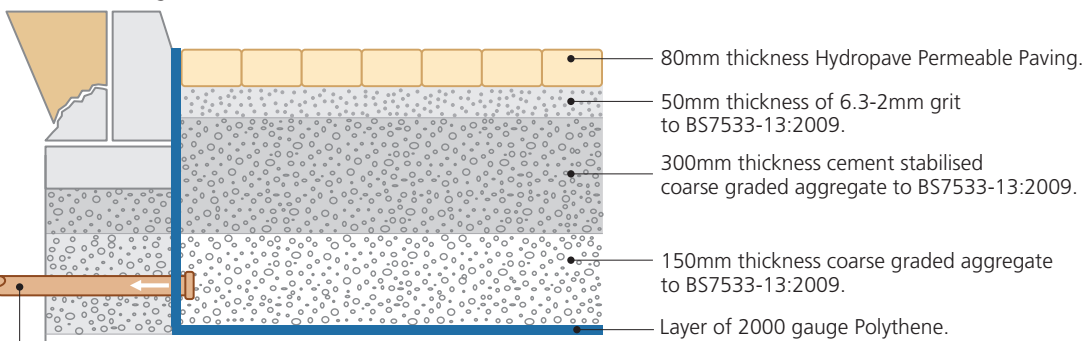
Sub-base & Capping Layers -

Capping thickness to be sufficient to provide a firm working platform or in the case of low CBR subgrade ground stabilisation may be more cost effective.

Outflow pipe - diameter according to project requirements (with perforated End Cap to prevent blockage of the pipe and a Top Hat Seal is used to achieve a water tight connection)

LOADING CATEGORY 6 1-5%CBR

Conventional edge restraint



For DBM alternative please refer to table on page 3.

Sub-base & Capping Layers -

Capping thickness to be sufficient to provide a firm working platform or in the case of low CBR subgrade ground stabilisation may be more cost effective.

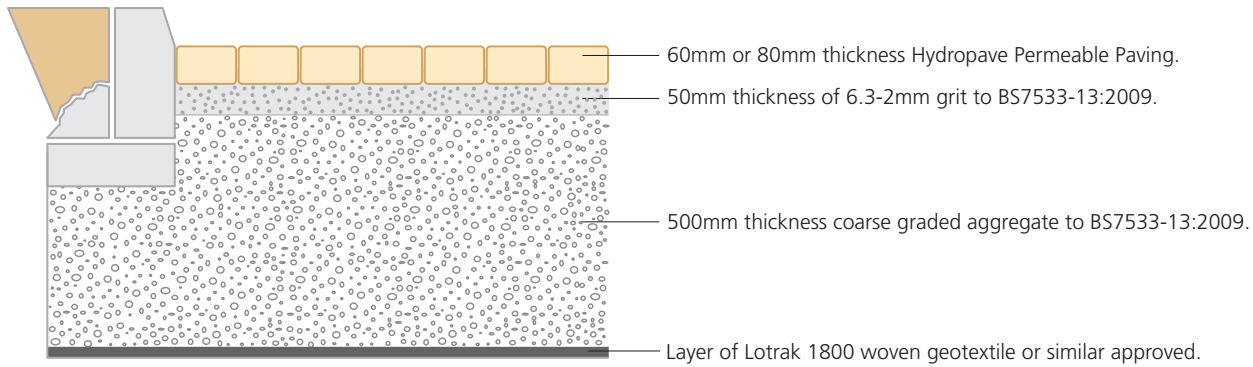
Outflow pipe - diameter according to project requirements (with perforated End Cap to prevent blockage of the pipe and a Top Hat Seal is used to achieve a water tight connection)

infiltration designs

NOTE : 1 & 2 % CBR - ground not suitable

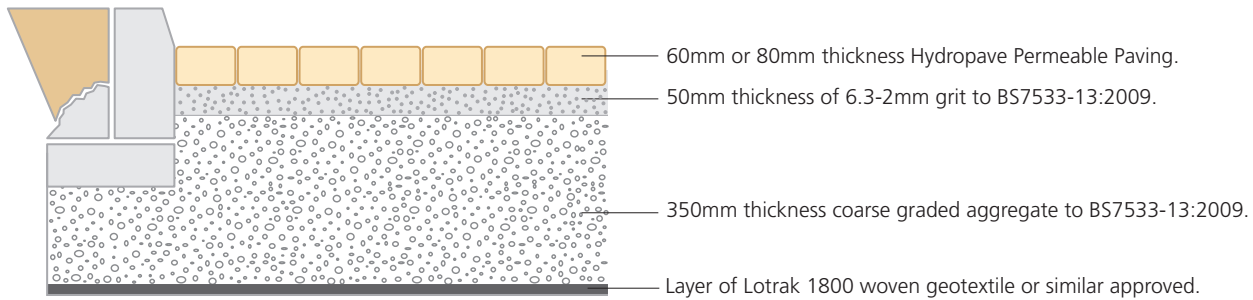
LOADING CATEGORY 2 3 & 4% CBR

Conventional edge restraint



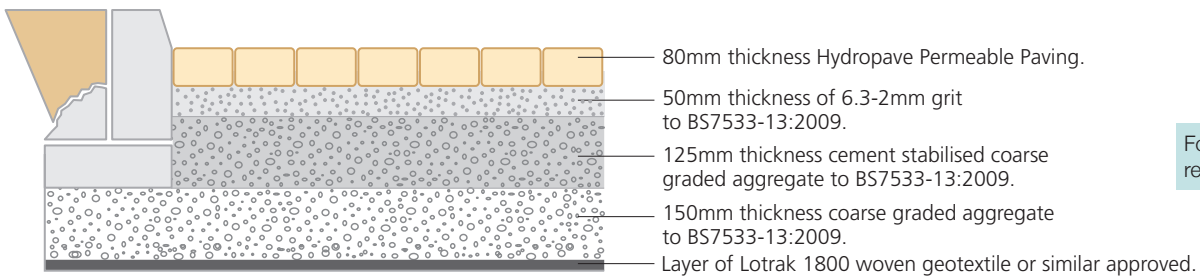
LOADING CATEGORY 2 5% CBR

Conventional edge restraint



LOADING CATEGORY 3 5% CBR

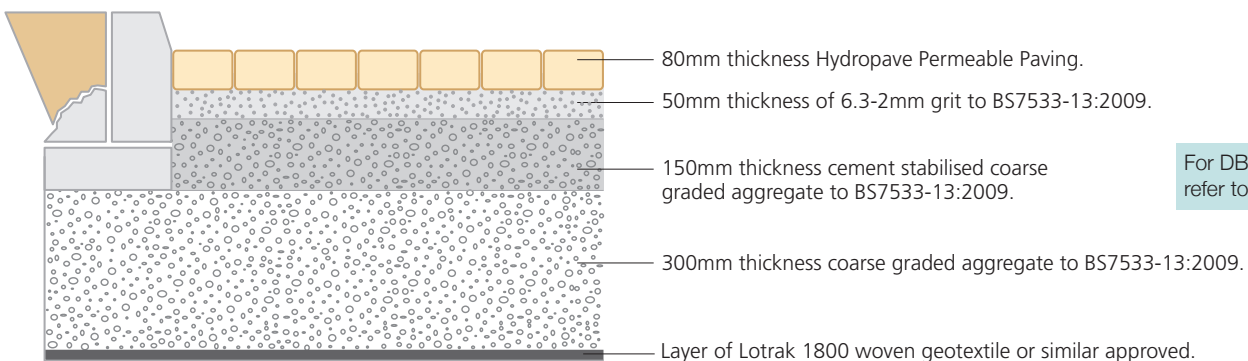
Conventional edge restraint



For DBM alternative please refer to table on page 3.

LOADING CATEGORY 4 3 & 4% CBR

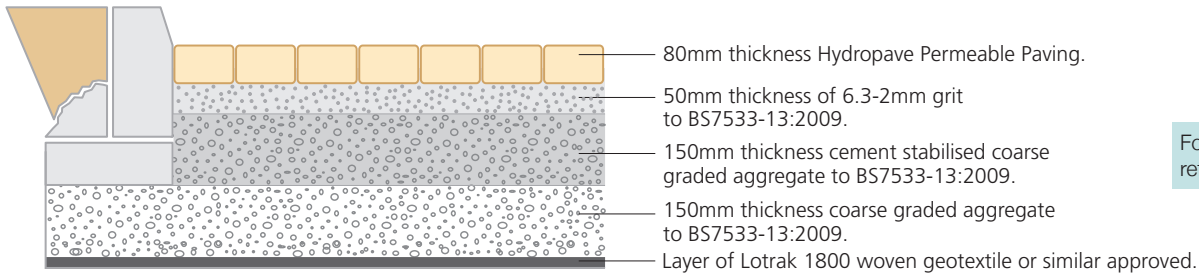
Conventional edge restraint



For DBM alternative please refer to table on page 3.

LOADING CATEGORY 4 5% CBR

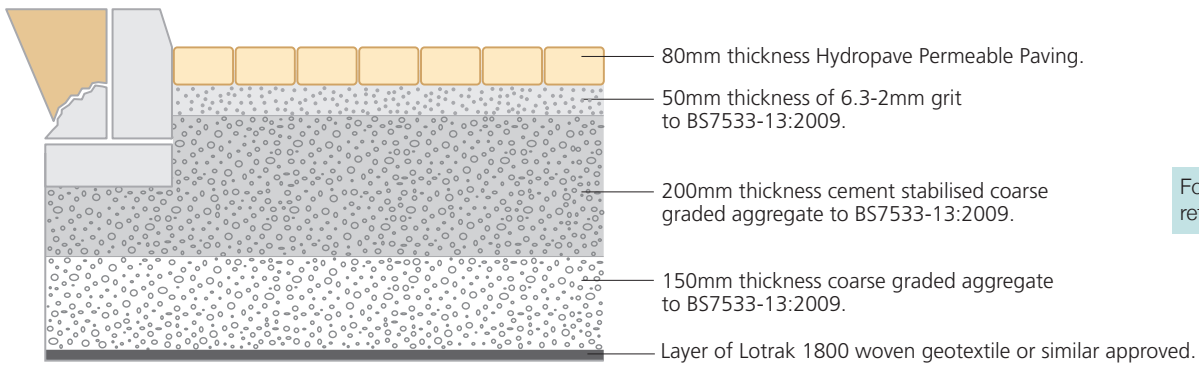
Conventional edge restraint



For DBM alternative please refer to table on page 3.

LOADING CATEGORY 5 5% CBR

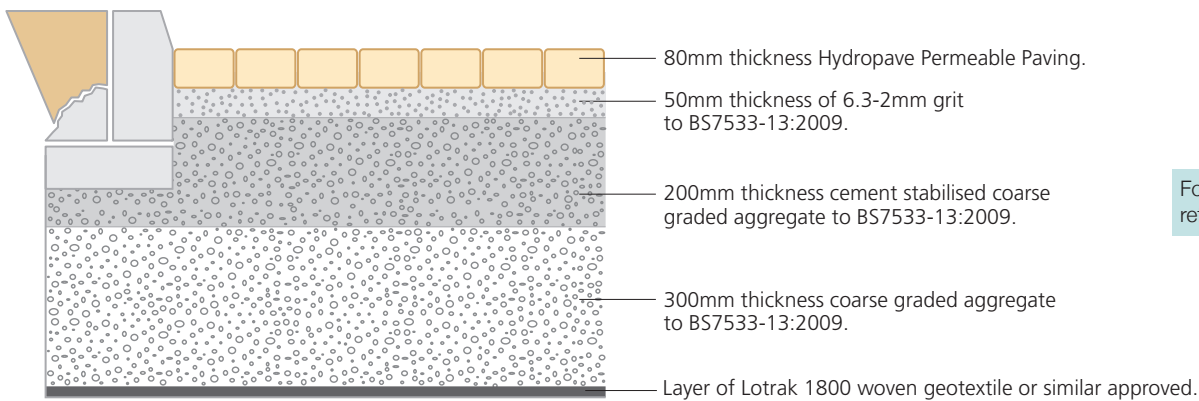
Conventional edge restraint



For DBM alternative please refer to table on page 3.

LOADING CATEGORY 6 3 & 4% CBR

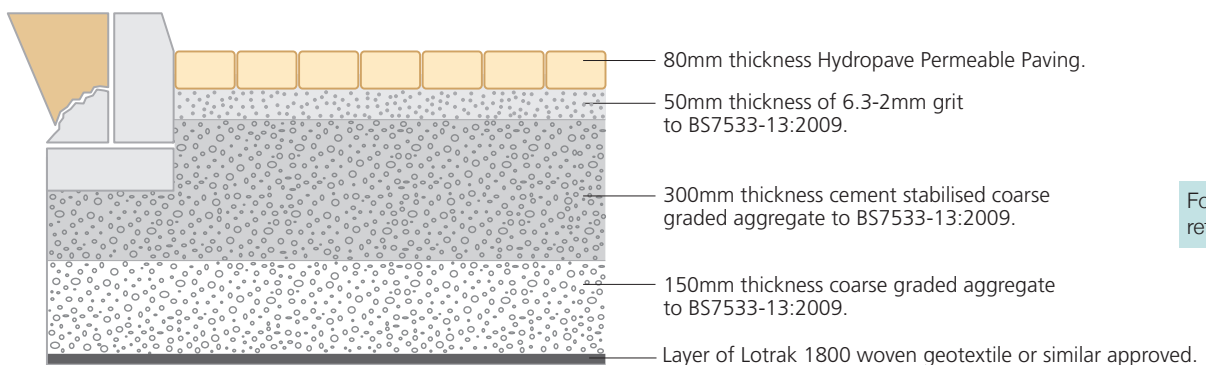
Conventional edge restraint



For DBM alternative please refer to table on page 3.

LOADING CATEGORY 6 5% CBR

Conventional edge restraint



For DBM alternative please refer to table on page 3.

instructions & warnings

Tobermore strives to ensure that any advice or information is accurate. No liability or responsibility of any kind (including liability for negligence) is accepted by Tobermore or its servants.

Technical information

Tobermore excludes liability for any loss or damage resulting from any inaccuracy or insufficiency in the information or specification(s) supplied to Tobermore to enable it to provide any technical information in relation to the Product.

Any technical information provided by Tobermore in relation to the Product (whether before or after Product order) is provided by way of GUIDANCE ONLY and, as permitted by law, without liability on the part of Tobermore for any loss or damage suffered as a result of relying upon it. Such technical information is not to be relied upon in substitution for obtaining independent expert advice, prior to using the Product, from both a suitably qualified engineer and building contractor, in particular, as to the suitability of the Product and its design for both the intended site and the project plan to develop that site.

Product information

Product design and development is a continuing process and Product information is subject to change by Tobermore without notice. Customers should check with Tobermore to ensure they have the latest details.

Product

All products should be carefully inspected for defects or damage before use. As permitted by law, Tobermore excludes liability for both the replacement costs and/or delay suffered as a result of having laid or fitted defective or damaged Product.

Colours-pigments & illustrations

Tobermore produces paving products with excellent density and durability. However, as with all concrete products, slight colour variations and/or weathering may occur. Tobermore excludes liability for any such colour variations and/or weathering.

All colour illustrations shown in this brochure are as accurate as the printing process will allow. For a more accurate colour match, please refer to actual Product samples available from any of Tobermore's Paving & Walling Centres.

Although every effort is made to ensure consistency of product colour, variations between production batches can occur. We therefore recommend that, when purchasing materials, especially in larger quantities, they all come from the same batch and that products are thoroughly mixed on site by drawing from a minimum of three packs. Tobermore cannot accept responsibility for this.

The colour of new paving bricks will inevitably vary compared to older bricks, which have been laid for a period of time. Tobermore cannot accept responsibility for this.

Laying multi-blend coloured bricks

To achieve an even blend or colour when laying multi-blend bricks, it is desirable to mix the bricks from three or four different pallets.

Efflorescence

Efflorescence is a white crystalline deposit that occurs naturally on the surface of masonry materials. If it occurs, efflorescence may mask the colour of the Product for a period of time, but tends to be washed away gradually by rain. Tobermore excludes liability for the occurrence of efflorescence.

Surface scratches

When paving bricks are laid they sometimes have minor scuffs or bruises, caused mainly by the laying and plate vibrating process. In our experience these marks usually weather off through time. Tobermore cannot accept responsibility for this.

Product maintenance & cleaning

Routine cleaning and maintenance is required to keep the overall appearance of the product in pristine condition. For further details please contact the sales office.

Light coloured blocks, emphasise tyre marks and oil spills on the driveway. It must be accepted that these products will need more maintenance if the overall appearance is to be maintained.

Ordering

To avoid waste, you should get your paving contractor to measure the area accurately on site, before ordering material as we often find that dimensions

taken from a project plan can vary significantly from the final layout. (See also under Colours)

Returns

Please note that Tobermore do not accept returns on any materials.

Queries & complaints

Please contact one of Tobermore's Paving & Walling Centres or offices with any queries and/or complaints. Any complaints must be notified to Tobermore without delay.

Manufacturing standards

All Tobermore products are manufactured to meet or exceed British and European Standards. Tobermore use an Integrated Management System for all Health & Safety and Environmental issues.

Quality systems

Tobermore are an BS EN ISO 9001:2000 and BS EN ISO 14001 registered company.

British Standards (BS)

Block Paving is now an established product in the construction industry and has a number of British Standards (BS) dedicated to the range to ensure it is professionally installed. Please refer to the following relevant BS guidelines for detailed information.

- **BS 7533-1:2001** Pavements constructed with clay, natural stone or concrete pavers. Guide for the structural design of heavy duty pavements constructed of clay or concrete pavers.
- **BS 7533-2:2001** Pavements constructed with clay, natural stone or concrete pavers. Guide for the structural design of lightly trafficked pavements.
- **BS 7533-3:2005** Pavements constructed with clay, natural stone or concrete pavers. Code of practice for laying precast concrete paving blocks and clay pavers for flexible pavements.
- **BS 7533-11:2003** Code of practice for the opening, maintenance and reinstatement of pavements of concrete, clay and natural stone.
- **BS 7533-13** Pavements constructed with clay, natural stone or concrete pavers. Guide for the structural design of permeable pavements.

Note

BS guidelines are subject to change and therefore you should refer to www.bsi-global.com for the latest version.

Other important references include - British Port Association heavy duty pavement design manual: "The structural design of heavy duty pavements for ports and other industries".



Tobermore

www.tobermore.co.uk