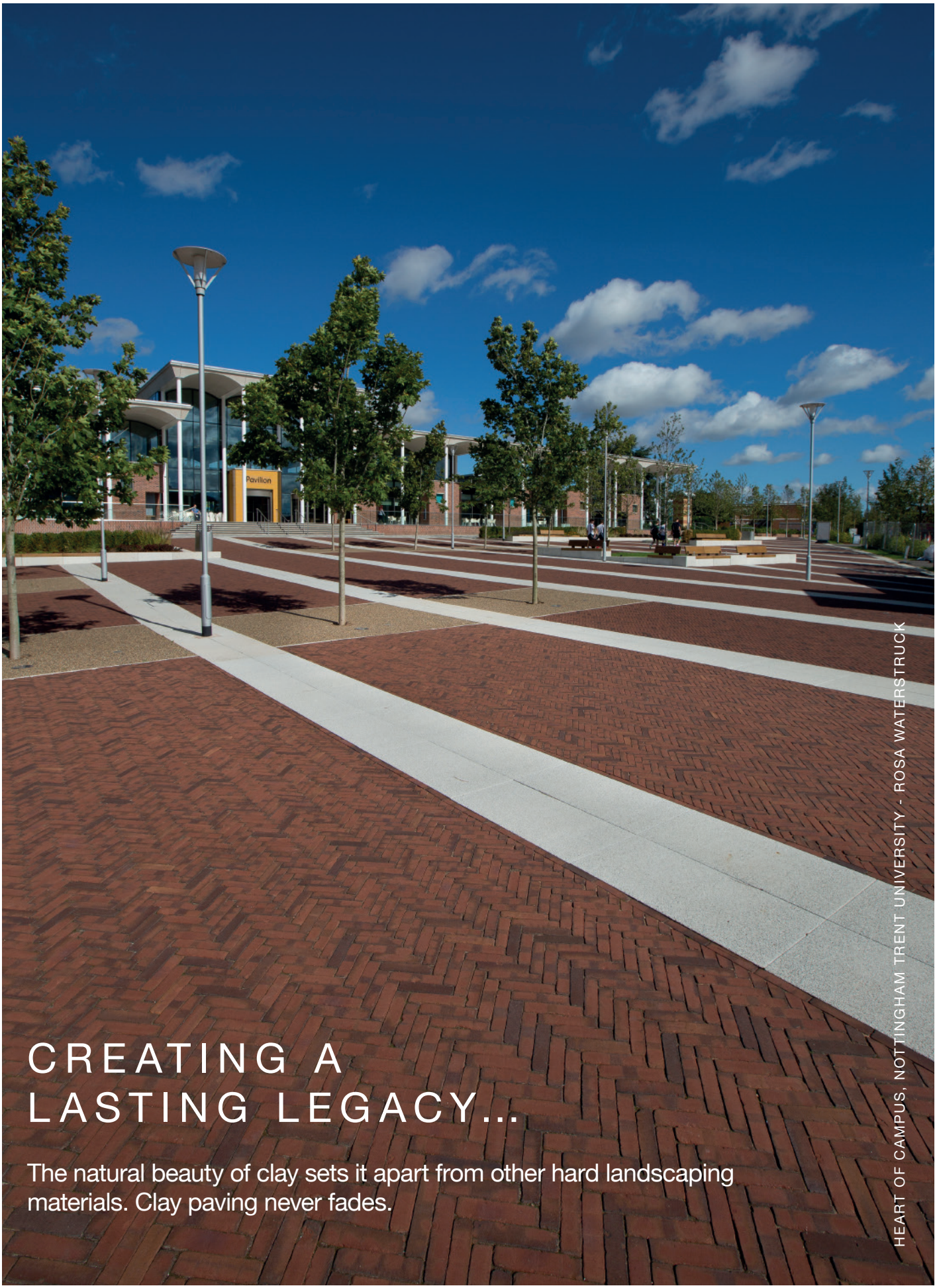
SOUTHWATER ONE , TELFORD - SIENA

CLAY PAVING

TECHNICAL AND SPECIFICATION GUIDE

Wienerberger



CREATING A LASTING LEGACY...

The natural beauty of clay sets it apart from other hard landscaping materials. Clay paving never fades.

HEART OF CAMPUS, NOTTINGHAM TRENT UNIVERSITY - ROSA WATERSTRUCK

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CONTENTS

TECHNICAL INFORMATION

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BRITISH & EUROPEAN STANDARDS

Wienerberger clay pavers are produced and tested to the relevant and current British Standards. Testing is carried out at accredited independent testing laboratories.

MANUFACTURING STANDARDS & TESTING REQUIREMENTS

British/European standard BS EN 1344:2013

TEST METHODS

Mean Transverse Breaking Load

Class	Transverse Breaking Load N/mm	
	Mean Value	Minimum Individual Value
T0	No Requirement	No Requirement
T1	>30	>15
T2	≥30	>24
T3	>80	>50
T4	>80	>64

Unpolished slip/skid resistance

Class	Mean SRV
U0	No determination
U1	35
U2	45
U3	55

Dimensional Deviation (Range)

Class	Range (mm)
R0	No determination
R1	$<0.6\sqrt{d}$

Where d is the work dimension (mm)

Abrasion resistance

Class	Mean abraded volume (mm^3)
A1	<2100
A2	<1100
A3	<450

Durability (freeze/thaw resistance)

Class	Performance
FP0	No Requirement
FP100	Freeze/ Thaw resistant

TEST METHODS

Breaking load

The British Standard breaking load test imitates the extreme case of the possible field loading; where there is no support from the sides and the laying course has failed.

All Wienerberger clay pavers achieve the highest breaking load classification (T4).

Slip/Skid Resistance

The slip/skid test is measured in Pendulum Test Value (PTV) or Slip Resistance Value (SRV). The higher the value the lower the potential for slip.

Tolerance

Due to the manufacturing process - clay pavers generally have higher tolerances than other landscaping materials.

Abrasion

Wienerberger clay pavers are extremely durable. The abrasion test is undertaken with a disc of abrasive material wearing away at the paver sample. The volume of the groove determines the abrasive resistance of the paver.

Durability

The test specimens are soaked in water; cooled until the water is frozen and then repeatedly frozen and thawed 100 times.

DESIGN

Clay paving should be designed in accordance with the relevant section in BS 7533

STRUCTURAL DESIGN	CLAY PAVING
Heavy Traffic (0.5 – 12msa*)	BS 7533-1:2001
Light Traffic (up to 0.5msa*)	BS 7533-2:2001

** million standard axles*

CONSTRUCTION CODES OF PRACTICE

Clay paving and kerbs should be installed in accordance with the relevant section in BS 7533

CLAY PAVERS	KERBS
BS 7533-3: 2005	BS 7533-6:1999

DESIGN GUIDANCE

PAVEMENT TYPES

Pavements constructed of clay paving should be designed in accordance with the relevant sections of BS 7533.

The long-term performance and durability of pavements constructed of clay paving is dependent on the following factors:-

- Pavement system
- Traffic loading and frequency
- Sub-grade strength (CBR%)
- Drainage
- Laying Pattern
- Installation

The choice of pavement system is important to ensure correct performance. The table below assists to select the most appropriate system.

System	Advantages	Disadvantages
Unbound paving on unbound base **(Refer to page 8)**	• Usually most cost-effective • Easy to replace/repair • Simple installation • Pavers can be reused • Good load transfer	• Susceptible to creep • Susceptible to loss of laying course sand • More onerous maintenance • Permits some water percolation
Bound paving on bound base **(Refer to page 8)**	• Excellent long-term performance • Good over poor sub-grade • Matches harmoniously with mortared walls • Less onerous maintenance	• Must have rigid base • Most expensive system • Requires movement joints • More labour intensive
Permeable paving on permeable base **(Refer to page 8)**	• No requirement for additional drainage • Provides groundwater recharge • Reduces stormwater runoff • Acts as a filtration system when water is passed through joints • No requirement for pavement falls • Water can be harvested and used for irrigation	• Requires special “nibbed” pavers • Deeper understanding of sub-grade • Generally used on relatively flat ground • Requires specialist design • Requires maintenance to ensure long lasting pavement • Risk of clogging (unless maintained)

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Figure 1

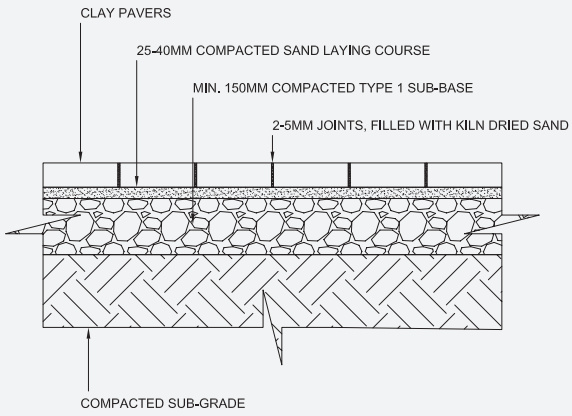


Figure 2

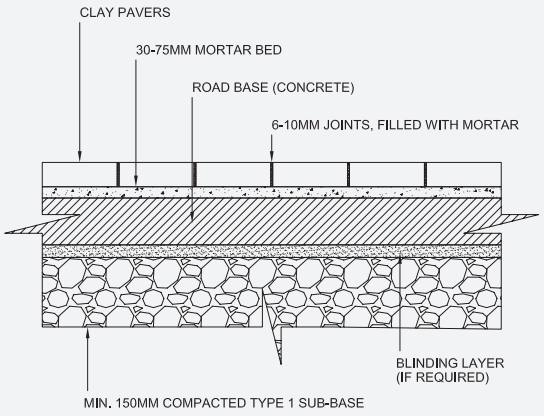
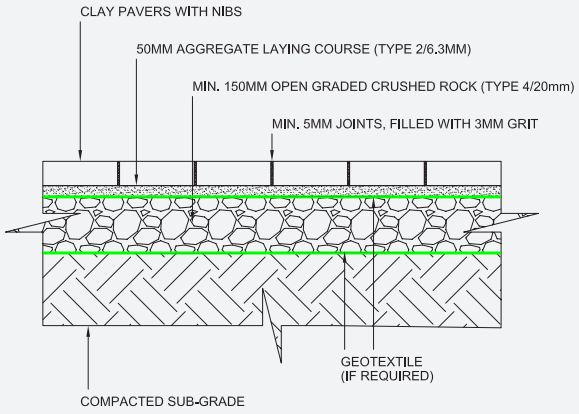


Figure 3



PAVEMENT TYPES


NOTTINGHAM UNI
ROSA WATERSTRUCK

Unbound (flexible) Pavements

Unbound pavements are based on the principle that traffic loads are transmitted downwards from the surface by spreading over an increasingly large area, by carrying it deep into the underlying layers.

The pavers are placed close butting on a 25-40mm thick bed of course sharp sand, and compacted into position, with additional kiln dried sand brushed into the joints. Pavers are to be laid with 2-5mm joints. The friction created by the sand jointing material results in the pavement acting as a whole, with loads being transferred to adjacent pavers.


EMPIRE WAY, WEMBLEY
PADOVA LF

Bound (rigid) Pavements

Bound clay pavements can be utilised in a wide variety of applications including domestic pathways, driveways, patio areas, pedestrian areas and can also be used where heavy traffic loads are expected. The principle behind a bound pavement is that the layers above the sub-base are wholly rigid, stiff and transmit loads to the underlying layers.

Bound pavements need careful consideration and detailing as they require extra design features to ensure the pavement can withstand the proposed traffic.


DARWIN HALL
AQUATA

Permeable (SUDS) Pavements

Permeable pavements allow surface water to infiltrate through voids created by pavers with unique nib designs. The pavement is designed to store and/or infiltrate water into underlying sub soils to reduce the impact of flooding.

Permeable pavements require specialist design.

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CLAY PAVING THICKNESSES

Wienerberger clay pavers are available in a wide range of thicknesses to suit the varying levels of traffic. It is important to note that the loading characteristics of the pavement heavily rely on the total pavement construction – not just the paver itself.

Pavement Type/Max Loading	Minimum clay paver thickness (mm)
Car Park receiving no heavy traffic	62-65mm
Car Parks receiving occasional heavy traffic (commercial)	70mm
Areas subject to regular heavy traffic (lorries max. speed 35mph)	85mm

PAVEMENT DESIGN

DESIGN ASSESSMENT – FOR FLEXIBLE PAVEMENTS

Step 1 - Traffic assessment

The traffic assessment design should take into account the cumulative traffic which the pavement has to carry. This is measured in cumulative vehicles per day (cv/d) or the number of standard axles (axle carrying a load of 8,200kg). Further advice on Traffic Assessment can be found in DMRB Volume 7 Section 2 Part HD24/06. These are categorised below (BS 7533):-

Typical Application	Category	Max. trafficking (msa)	(Cv/d)
Private Drives, Pedestrian Traffic	VI	-	-
Car Parks, No heavy traffic, Footways receiving no vehicle traffic	IIIb	-	nil
Pedestrianised areas receiving only occasional heavy traffic	IIIa	-	<1
Car Parks receiving occasional heavy traffic. Footways regularly overridden by vehicular traffic	II	0.5	<5
Adopted highways and other roads less than 0.5msa e.g. cul-de-sacs, petrol station forecourts, pedestrianized areas subject to regular heavy trafficking			>5

For commercially heavily trafficked pavements (Category I) a more detailed design is required. Details can be found in BS 7533:1

Step 2 – Sub-grade Assessment

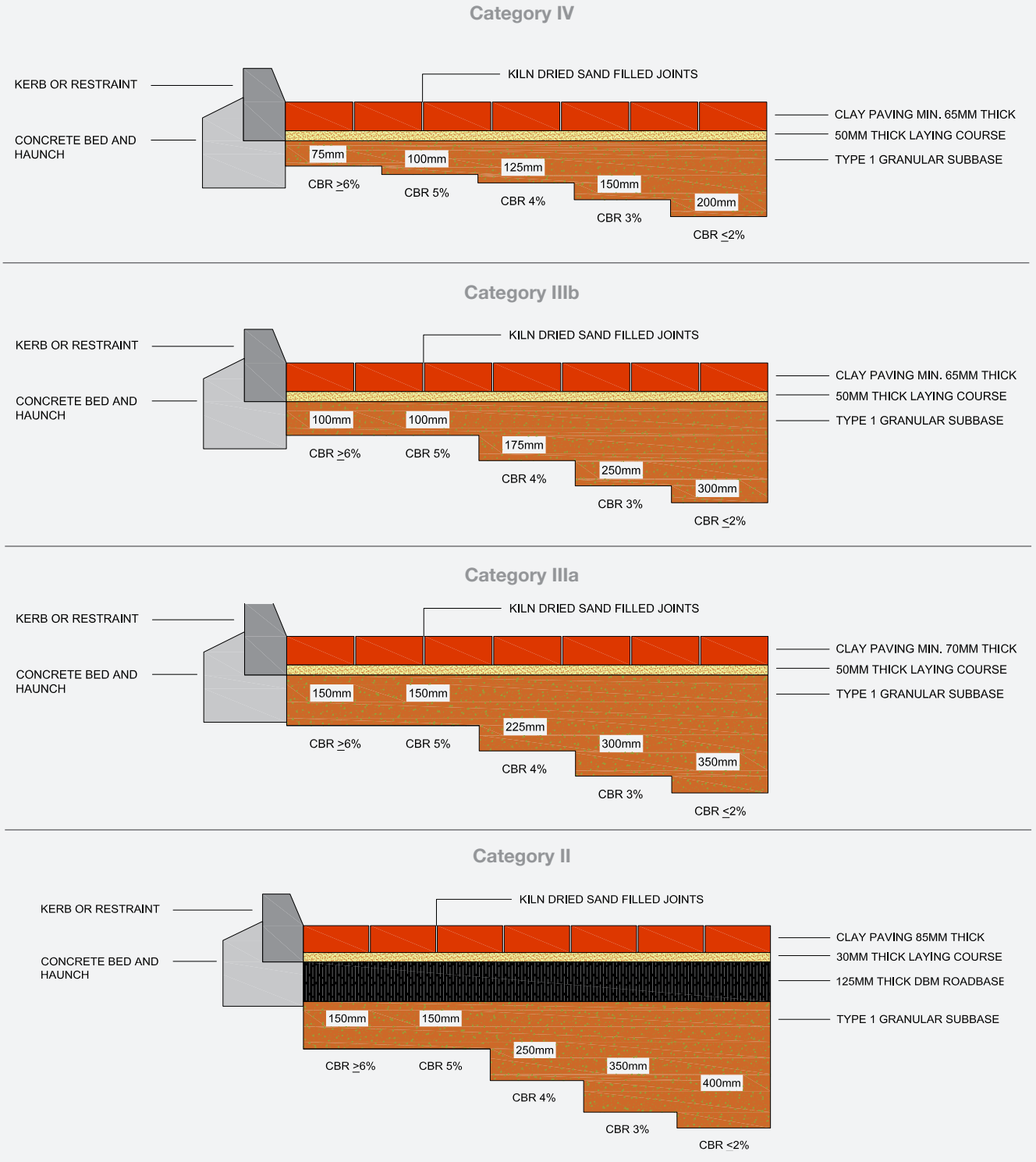
When the design traffic assessment has been determined it is necessary to understand the nature of the underlying sub-grade - in particular, the sub-grade strength or bearing capacity. This is determined through a simple site test known as the Californian Bearing Ratio (CBR) and is expressed as a percentage. The weaker the sub-grade (i.e. low CBR%), the stronger the pavement is required to be. The table below shows typical CBR % (equilibrium) values for various sub-grades (BS 7533:2):-

Type of soil	Estimated CBR
Heavy Clay	2-3%
Silty Clay	4%
Sandy Clay	5%
Silt	1%
Sand poorly graded	7-20%
Sand well graded	10-40%
Sandy gravel	15-60%

Sub-grades with a Design CBR <2.5% are generally deemed unsuitable for a pavement foundation. Sub-grade improvement layers will be required to permanently improve the load bearing capacity. These improvement techniques can be simply to remove the soft material and replace with a suitable material or introduce a lime and/or cement stabilisation technique. The incorporation of a geosynthetic material (geogrid) into the sub-grade improvement layer can be advantageous and may reduce the layer thickness. These materials help control the lateral movement in exceptionally weak ground by interlocking and stiffening the aggregate layer so load spread is increased, vertical stress is reduced and performance is improved.

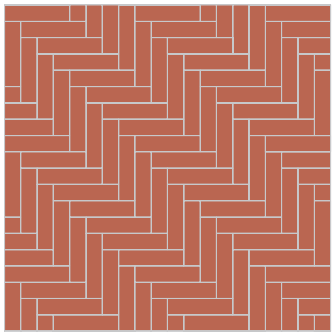
Step 3 – Foundation and pavement thickness design

Images below show the required foundation and pavement component thicknesses for Categories II, IIIa, IIIb and IV.

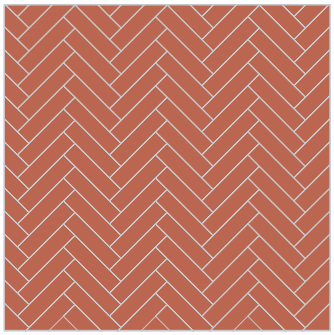


LAYING PATTERNS

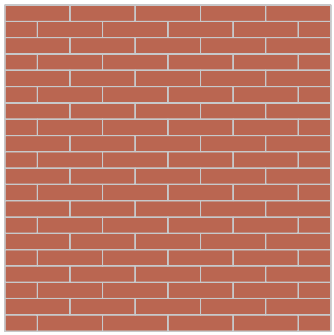
Dutch Pavers - WF Format



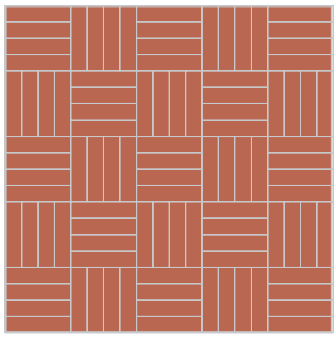
90° Herringbone
Using WF format clay pavers (200x48x85mm)



45° Herringbone
Using WF format clay pavers (200x48x85mm)

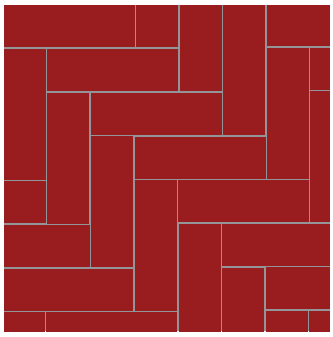


Stretcher Bond
Using WF format clay pavers (200x48x85mm)



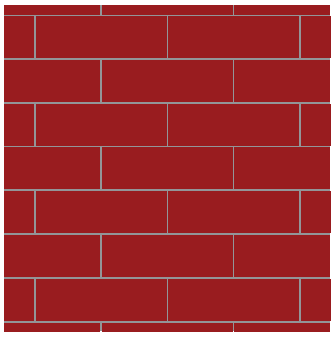
Basket Weave
Using WF format clay pavers (200x48x85mm)

Dutch Pavers - DF Format

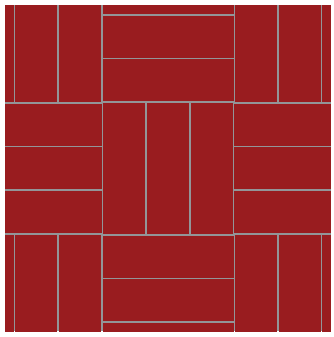


90° Herringbone
Using DF format clay pavers (200x64x85mm)

45° Herringbone
Using DF format clay pavers (200x64x85mm)

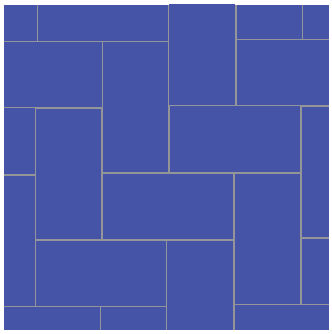


Stretcher Bond
Using DF format clay pavers (200x64x85mm)



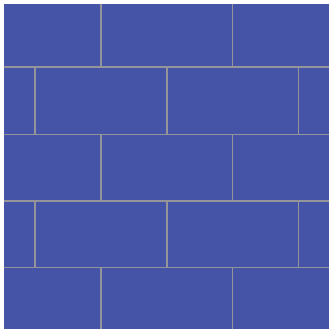
Basket Weave
Using DF format clay pavers (200x64x85mm)

Rectangular Pavers (Chamfered & Baggeridge)



90° Herringbone
Using rectangular clay pavers (200x100)

45° Herringbone
Using rectangular clay pavers (200x100)



Stretcher Bond
Using rectangular clay pavers (200x100)

Similar patterns can be used for UWF Tumbled pavers & SlimPave pavers. Other more elaborate laying patterns can be used to create unique landscapes.

Please see our laying pattern guide here.

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INSTALLATION GUIDANCE

UNBOUND (FLEXIBLE) PAVEMENTS

Prepare sub-grade

The sub-grade shall be cut and formed to the required level ensuring no soft spots. Any soft spots are to be removed and replaced with appropriate material.

Lay and compact sub-base

The sub-base material is spread and compacted in layers. The choice of compaction equipment is important – a vibrating compactor plate may not be suitable for large scale projects. A vibrating roller would be more appropriate. The surface of the compacted sub-base should be close textured to prevent any loss of bedding course material. The sub-base should be laid to falls to allow for drainage gradients.

Install edge restraints

Install appropriate edge restraints along the perimeter of the area to be paved. When using kerbs ensure the concrete bed/haunch has matured before any compaction is undertaken.

Spread, compact and screed bedding course

Spread the sand in a loose uncompacted layer over the area to be paved; compact the sand with a vibrating plate compactor. The compacted sand is then screeded to level to receive the pavers. It is essential that the sand bedding course is not disturbed (i.e. through foot traffic, etc.).

Lay pavers, fill joints and compact

When the bond pattern has been determined, it is good practice to lay a control sample panel in order for the final pavement to be consistent and all site personnel/paving contractors are aware of the proposed paving design. Paving work may start from an exact edge or the centreline of the pavement. String lines may be used to keep the pattern straight. Straight lines are necessary in areas subject to vehicular traffic to provide an even spread of horizontal load.

Whole pavers should be laid first, followed by cut pavers. The pavers are laid in the desired bond pattern with a joint width between 2-5mm – with a target joint width of 3mm. Pavers that butt directly to each other tend to spall (chip) as the pavement moves.

After the area has been laid with whole pavers; special infill pavers or cut pavers are placed in the spaces. Pavers should be cut with a masonry saw or special clay paver block splitter to ensure clean and accurate cuts. Clay paving should not be cut to less than a quarter of its original size along the length of the paver and never across the width – where required, complimentary fittings and inboard cutting should be used.

When the pavers have been placed on the bedding course, the pavement is vibrated using a vibrating plate compactor. Compaction should not occur closer than one metre to the unrestrained working edge of the pavement under construction. The compactor should be fitted with a neoprene sole plate or alternatively a sheet of plywood can be laid over the pavers to protect them from the compactor.

After the first compaction, jointing sand is spread on to the surface and brushed into the joints. The pavement then received 2 or 3 passes of the vibrating plate. Further jointing sand should be swept into the joints and re-compacted until all the joints are full.

BOUND (RIGID) PAVEMENTS

Install concrete road base

Where a concrete road base is used ensure properly designed movement joints are installed. The concrete base surface should be finished smooth and allowed to harden overnight.

Lay mortar bedding course

A primer may be required between the road base and the mortar bedding course (subject to design). The mortar bed is laid typically 35-50mm thick.

Lay pavers, fill joints and compact

When the bond pattern has been determined, it is good practice to lay a control sample panel in order for the final pavement to be consistent and all site personnel/paving contractors are aware of the proposed paving design.

Paving work may start from an exact edge or the centreline of the pavement. String lines may be used to keep the pattern straight. Straight lines are necessary in areas subject to vehicular traffic to provide an even spread of horizontal load.

Whole pavers should be laid first, followed by cut pavers. The pavers are laid in the desired bond pattern with a joint width between 6-10mm.

After the area has been laid with whole pavers; special infill pavers or cut pavers are placed in the spaces. Pavers should be cut with a masonry saw or special clay paver block splitter to ensure clean and accurate cuts.

When all the pavers are laid, a slurry mix of jointing mortar can be poured into the joints ensuring all joints are fully topped up – any surplus is washed off with water.

PERMEABLE (SUDS) PAVEMENTS

Lay and compact sub-base

The sub-base is laid in layers (150mm thick) and compacted using non-vibrating compaction equipment – a roller is the most effective.

Spread and screed bedding course

The aggregate is spread and screeded to 50mm thick. The bedding course is not compacted.

Lay pavers, fill joints and compact

When the bond pattern has been determined, it is good practice to lay a control sample panel in order for the final pavement to be consistent and all site personnel/paving contractors are aware of the proposed paving design.

Paving work may start from an exact edge or the centreline of the pavement. String lines may be used to keep the pattern straight. Straight lines are necessary in areas subject to vehicular traffic to provide an even spread of horizontal load.

Whole pavers should be laid first, followed by cut pavers. The pavers are laid in the desired bond pattern.

After the area has been laid with whole pavers; special infill pavers or cut pavers are placed in the spaces. Pavers should be cut with a masonry saw or special clay paver block splitter to ensure clean and accurate cuts. When all the pavers are laid, jointing material is brushed into the open joints. The pavement is then vibrated using a plate compactor. Further jointing material is the brushed in to the joints ensuring all joints are fully topped up.

MAINTENANCE

1. Early trafficking and cleaning

If the pavement has unbound joints traffic may use the pavement immediately following the final pass of the vibrating plate compactor. At this stage the joints between the pavers will be relatively porous. Cleaning should be by hand broom only for this period. Cleaning with hoses or mechanical sweepers with vacuum attachments is not recommended during the first 3 months. Following the ingress of water, together with general dirt and detritus, the jointing sand will consolidate and become relatively impervious.

2. Basic cleaning principles

General

Clay paving provides a durable and hard wearing surface, but like any other paving material, may suffer from staining. Frequent sweeping and washing reduces the effect of dirt and grime and maintains the attractiveness of a pavement. The removal of stains need not be a problem if the following principles and procedures are followed.

Select correct cleaning solutions

Is the use of chemicals necessary? If clean water and a detergent fail to work then the answer could be yes. Do not automatically reach for an acid cleaner, establish what the contaminant is.

3. Removing common stains

Efflorescence

The majority of clay pavers have a low soluble salt content and a slight white bloom may appear on the surface immediately after laying. The source of this stain is most likely to be derived from the jointing sand.

These salt deposits are usually harmless and can be removed by dry brushing and allowing to weather away naturally.

Efflorescence may also manifest itself when pavers start to dry out following the seasonal use of de-icing salts, particularly in town centre pedestrian areas. Normal weathering will remove this discolouration. Special urea based gritting salts are available to minimise this problem.

White scumming

This is often seen as a thin white film on the paving surface if there is contamination from an external source, e.g. concrete structures discharging their run off, or even the leaching of certain limestone sub bases. It may also appear after an attempted removal of mortar stains or after the sanding of joints with ‘clayey’ sand (i.e. sand contaminated with clay content).

General dirt and grime

Frequent sweeping and hosing will usually ensure a clean pavement. If this is not enough then washing with a detergent may be required. Any use of pressure washing may require the replacement of jointing sand.

Vanadium stains

Buff or fireclay products in particular often contain vanadium salt that may appear as a yellow, green or red/brown discolouration of the pavers. Vanadium stains are naturally occurring and are neither permanent nor harmful and do not indicate any defect in the paver. Stains in exposed areas generally wash off in time but their removal can be hastened by chemical treatment. Refer to Design Services - design.uk@wienerberger.com.

Mortar stains

Experiment on a small section of the affected pavement with a weak solution of water mixed with hydrochloric acid. Once the appropriate strength of solution has been determined then follow the manufacturer's instructions in the removal of the stain. Clean area down with clean water once stain is removed.

Fungi, moulds, moss and lichens

These are common, particularly in shady or damp parts of the pavement. They will not damage the pavement but may cause it to become slippery. Remove by vigorously brushing the affected area when it is dry. Alternatively high pressure water may be used.

It is necessary to 'sterilise' the area with a strong fungicide/weed killer or proprietary brands from garden centres. Follow manufacturer's instructions and test their effect on a small area initially.

Oil, bitumen, tar

Oil does not penetrate into the body of clay pavers and will sit on the surface until it is dispersed naturally.

Scrape off any excess material when dealing with petroleum asphalt and bitumen or mop up immediately any petrol or oil stains using absorbent paper towels. Wiping and further spreading of the contaminants should be avoided.

Treat with commercial emulsifying agents, such as 'Gunk', following manufacturer's instructions. Subsequently, use detergent to clean up and rinse well with clean water.

Neither hot water, nor steam, nor emulsifying agents will affect the colour of the paving.

Food stains and tyre marks

Scrub with full strength commercial detergent and rinse well.

Chewing gum

The most serious of cleaning problem associated with town centre and public realm projects is chewing gum.

Wire brushes should remove the majority of chewing gum but it will require several attempts. Specialised high-pressure water jet lances and freezing methods have also been successful in varying degrees.

Paint and graffiti

Very difficult to remove. Soak up any wet paint with an absorbent material. Do not wipe as this will spread the paint. Treat with white spirit solvent followed by washing down of the area with a strong detergent and hot water/steam.

Dried paint should be scraped off and an appropriate paint stripper applied following manufacturer's recommendations. Wash the area down with a strong detergent and hot water/steam.

Alternatively, consult a specialist company should the affected area be large or as a result of vandalism.

Should all else fail, take up the affected area, turn the pavers over and re-lay.

TECHNICAL SUPPORT AND CAPABILITY

Wienerberger can offer a design and advice service for all our clay paving products. In addition to this service, Wienerberger are capable of providing:

- Permeable paving design and specification
- CAD drawings and take-off service
- Special paving and kerb products
- Installation advice and guidance
- NBS specifications
- RIBA Approved CPD
- Sample panel fabrication

Wienerberger Ltd
Wienerberger House,
Brooks Drive
Cheadle Royal Business Park
Cheadle, Cheshire
SK8 3SA

T: 0845 303 2524
F: 0844 334 4100

wbukmarketing@wienerberger.com

@wienerbergeruk

www.wienerberger.co.uk

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