SPECIFICATION OF CONCRETE BLOCK PAVING

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Interpave is a Product Association of the British Precast Concrete Federation Ltd.

Introduction

This document is intended to provide guidance with the specification of concrete block paved surfaces, including model specification clauses where appropriate. It is based on BS 7533-3 and is intended only for the use of experienced paving designers with a full understanding of block paving technology.

Manual for Highway Works

All the requirements of the Manual for Highway Works Series 1100 shall apply except where the requirements of the additional Interpave clauses supercede them. In particular, the following should be noted:

1107 Footways and Paved Areas (Concrete Block Paving)

1 (11/04) Precast concrete paving blocks shall be chamfered and shall conform to BS EN 1338 and the shapes, dimensions, colours and performances and classes described in Appendix 11/1.

2 (11/04) Precast paving blocks shall be laid in accordance with BS 7533-3, except that the subbase shall be one of the materials permitted in sub-Clause 1104.4.

3 The layout of blocks and details at edges, chamber covers, gullies and other openings shall be as described in Appendix 11/1.

Additional Interpave Clauses and Notes

NG1. Precast concrete paving blocks

1.1 Precast concrete blocks shall comply with the requirements of BS EN 1338. All blocks, are to be supplied by members of Interpave, The Precast Concrete Paving and Kerb Association.

1.2 Precast concrete blocks shall meet the requirements for the different applications as illustrated in Table 1.

Table 1. Guide to physical properties

Category (3)	Typical applications (3)	Minimum thickness (mm)	Tensile splitting strength & failure load	Abrasion	Skid/slip (pendulum value)	Freeze/thaw (kg/m^2)
I	0.5 to 12 msa	60 (2)	No block shall have a tensile strength less than 3.6mPa for a failure load less than 250 N/mm	≤ 20	45 min	≤ 1.0
II	Adopted highways and other roads less than 0.5 msa, e.g. cul-de-sacs, petrol station forecourts, pedestrianised areas subject to regular heavy trafficking. Car parks receiving occasional heavy traffic. Footways regularly overridden by vehicular traffic.	60		≤ 20	45 min	≤ 1.0
IIIa	Pedestrianized areas receiving only occasional heavy traffic. Footways overridden by occasional vehicular traffic.	50		≤ 23	45 min	≤ 1.0
IIIb	Car parks receiving no heavy traffic. Footways likely to be overridden by no more than occasional vehicular traffic.	50		≤ 23	45 min	≤ 1.0
IV	Private drives, paths, patios, hard landscaping. Areas receiving pedestrian traffic only, e.g. school playgrounds.	50		No requirement	20-39	No requirement

Notes

1. Dimensional Tolerances, measured in accordance with BS EN 1338:
   Thickness ± 3 mm
   Length/Width ± 2 mm
2. See BS 7533-1:2001, Table 3: paver thickness is determined by design
3. Categories and typical application definitions taken from BS 7533-2.

NG2. Tolerance of surface level and surface regularity

2.1 The recommended permissible deviation from the design level of the different layers are:

Conventional pavements

Sub-base	+5mm, – 10mm
Roadbase	+5mm, – 10mm
Laying course	30mm thickness, – 5mm, +10mm
Surface course	± 6mm

Permeable pavements

Sub-base	± 20mm
Roadbase	± 20mm
Laying course	50mm ± 20mm
Surface course	± 6mm

2.2 The recommended surface regularity of the surface course are:

Conventional pavements

Flatness of pavement	10mm under 3 m straight edge when laid
Difference in levels at the joints of adjacent paving units	2mm

Permeable pavements

Flatness of pavement	not applicable
Difference in levels at the joints of adjacent paving units	2mm

2.3 Where blocks are laid abutting drainage channels and outlets for pedestrian areas or fittings, the surface of the blocks shall be between 3mm and 6mm above the channel or fitting.

2.4 Where blocks are laid abutting gullies or drainage fittings, the surface of the blocks shall be between 5mm and 10mm above the gully grating and frame.

NG3. Preparation of subgrade for pavements

The preparation shall comply with the Manual for Highway Works.

3.1 The area to be paved shall be excavated to formation level and any unsuitable material removed from the subgrade and replaced with properly compacted material, with similar properties to the adjacent sound subgrade material.

3.2 Any sub-soil drainage located beneath the pavement shall be completed in conjunction with subgrade preparation, before commencement of the sub-layer construction.

3.3 All trenches within the pavement area shall be backfilled with suitable material in layers, with each layer compacted before the next is placed and its compaction shall not be inferior to the surrounding subgrade. Power rammers shall not be used within 300mm of any drain or service.

3.4 The surface level of the subgrade shall not deviate from the design level.

NG4. Sub-layers for pavements

General

4.1 The subgrade, sub-base and roadbase (if present) should be constructed such that:

a) the surface levels of the sub-base and roadbase are within tolerances

b) the longitudinal and cross falls of the completed paving are introduced at the subgrade level

c) the surface of the sub-base and roadbase is tight and dense to prevent laying course migration.

Conventional pavements

4.2 The sub-layer material shall comply with the relevant clauses from the Manual for Highway Works.

4.3 Any drainage provided within the sub-layer shall be completed in conjunction with the sub-layer construction before the laying course is placed. Drainage inlets shall be protected with filter fabrics to prevent ingress of laying course material.

4.4 The sub-layer material shall be placed and compacted in accordance with the Manual for Highway Works.

4.5 The finished sub-layer shall have, immediately before overlaying, a close-textured surface, be free from compaction planes, ridges, cracks or loose material and show no movement under the compaction plant.

4.6 The surface levels for each layer shall not deviate from the design level specified in clause 2.2.

Permeable pavements

4.7 The sub-base shall be constructed from coarse aggregate material conforming to Table 2.

Table 2. Grading of sub-base material

Sieve size mm	**Percentage by mass passing %**	
	4/40	**4/20**
80	100	—
63	98 – 100	—
40	85 – 99	100
31.5	—	98 – 100
20	20 – 70	85 – 99
10	—	20 – 70
4	0 – 15	0 – 15
2.8	0 – 5	0 – 5

4.8 There are three systems that can be used, depending on requirements:

System A – total infiltration, allows all water falling onto the pavement to infiltrate down through the joints or voids between the concrete blocks, passing through the constructed layers below and eventually into the subgrade. Some retention of the water will occur temporarily in the sub-base layer allowing for initial storage before it eventually passes through. System A is sometimes known as 'Zero Discharge', as no additional water from the new development is discharged into traditional drainage systems, therefore the need for pipes and gulleys is eliminated.

System B – partial infiltration, allows some water to infiltrate through the pavement, as with System A, but a series of perforated pipes or fin-drains is also introduced at the formation level to allow the remaining water to be drained to other systems such as sewers, swales or watercourses. System B can be used in situations where the existing subgrade may not be capable of absorbing all the water. This system can, therefore, prevent the existing soil from losing its stability. A fixed amount of water is allowed to infiltrate down through the system - which, in practice, often represents a large percentage of the rainfall. The excess is collected and eventually discharged into sewers or watercourses.

System C – no infiltration, allows for the complete capture of the water using an impermeable, flexible membrane placed on top of the formation level. It is used in situations where the existing subgrade has a low permeability or low strength and would therefore be damaged by the introduction of additional water. It can also be used for water harvesting or to protect sensitive existing conditions such as water extraction zones. A series of perforated pipes or fin-drains is placed on top of the impermeable membrane to transmit the water to sewers, watercourses or treatment systems. System C is particularly suitable for contaminated sites, as it prevents pollutants from being washed further down into the subgrade, where they may eventually be washed into existing natural water systems. Another advantage is storage capability, as stored water can eventually be released into existing systems at times of low-flow by mechanical means, preventing overloading at times of heavy rainfall. System C can also act as an underground retention zone and, in some instances, the stored or captured water can be collected, cleansed and re-used for other purposes, such as flushing toilets (i.e. 'grey water') or for irrigation. The introduction of a geosynthetic filter may assist in the pollutant cleansing process.

4.9 For System C – No Infiltration, the impermeable membrane must be correctly specified, installed and treated with care to ensure that it is not damaged during construction.

4.10 The surface levels for each layer shall not deviate from the design level specified in clause 2.2.

4.11 The minimum time lapse between laying concrete or cement bound material sub-layers and blocks shall be as given in the Manual for Highway Works. Any areas, which have become defective shall be removed to the full depth of the layer, relaid with new material and recompacted.

4.12 The pavement shall be protected to ensure no impermeable contaminants such as soil and mud enters the base and pavement surface both during and after construction. Keep muddy construction equipment away from the area, installing silt fences, staging excavation and constructing temporary drainage swales to divert runoff away from the area. Water ponding on the surface indicates that there is insufficient infiltration and the joints/voids may require sweeping clean or, in extreme cases, replacing. Any depressions, rutting, cracked or broken blocks, considered to be detrimental to the structural performance of the pavement or a hazard to users, will require the appropriate corrective action.

NG5. Restraint

5.1 Restraint shall be sufficiently robust to withstand override by any anticipated traffic.

5.2 The edge restraint should present a vertical face down to the level of the underside of the laying course.

5.3 Intermediate restraint may be needed in certain applications, normally between junctions of different materials.

5.4 Temporary restraints might be needed to prevent paving units moving during construction or for areas that cannot be completed for some time.

5.5 Edge restraints shall be provided around all areas of blocks.

5.6 Edge restraints may be formed by existing structures, kerbs, channels, edgings, blocks set on concrete, etc. Edge restraints shall be capable of preventing the loss of laying course sand and the sideways movement of blocks, and of supporting anticipated traffic loads.

NG6. Laying course material

Conventional pavements

6.1 The laying course material shall complying with the grading requirements specified in Table 4, based on application, as shown in Table 3.

Table 3. Sand category for different applications

Laying Course Category	Application
1A	Aircraft pavements Bus stations Pavements with severely channelised traffic
1B	Industrial pavements Loading bays
II	Adopted highways Roads Petrol station forecourts Pedestrianisation schemes with regular heavy traffic
III	Car parks with some heavy vehicles Footways with frequent vehicle overrun
IV	Private driveways Areas with only Footways with occasional vehicle overrun

6.2 Grading requirements of laying course material shall be as given in Table 4. The laying course shall have a nominal compacted thickness of 30mm.

Table 4 Grading requirements of laying course material

Sieve (mm)	% Passing	
8	100	100
6.3	95	100
4	85	99
0.5	30	70
0.063	0	**X**

For '**X**' shown in Table 4, read values from Table 5 for the different applications (Site Categories).

Table 5. Limits on fine aggregate

Site Category	**1A**	**1B**	**II**	**III**	**IV**
Passing 0.063mm (max) (f)	0.3%	0.5%	1.5%	3.0%	4.0%

Permeable pavements

6.3 The laying course shall consist of material complying with Table 6.

Table 6. Grading for laying course material

Sieve size mm	**Percentage by mass passing %**
14	100
10	98 – 100
6.3	80 – 99
2	0 – 20
1	0 – 5
0.063	0 – 2 (BS EN 12620 fines category f_2)

6.4 The laying course shall have a nominal compacted thickness of 50mm.

NG7. Preparation of laying course

7.1 Before commencement of the block laying, the preceding work i.e. base construction, edge restraints, features and penetrations within the pavement such as drainage channels, inspection pits etc., shall be checked to ensure they are in compliance with the contract requirements. Particular attention shall be paid to the base levels and tolerances to ensure that when the block layer is completed the surface levels are compliant.

Any non-conformances in the preceding works shall be corrected before commencing the block layer construction.

The construction of the block paving layer shall be carried out by a member of Interlay.

Conventional pavements

7.2 The laying course material shall be prepared using one of the following methods:

(i) Compaction of laying course - spread out laying course material in one layer, to a depth sufficient to give the required compacted nominal thickness and compact with a vibrating plate compactor. Level the surface by screeding.

Note: this method is recommended when mechanically laying block paving.

(ii) Uncompacted laying course - spread out loose laying course material in a uniform layer. Screed the material to a depth sufficient to give the required compacted nominal thickness after compaction of the material and blocks.

7.3 If the laying course material becomes saturated after laying then it should be removed and replaced with laying course material having the correct moisture content or alternatively the laying course can be left in place until it dries sufficiently to allow block laying to proceed.

Permeable pavements

7.4 The screeding of the laying course material shall be performed as in 7.2 (ii)

NG8. Laying pattern

8.1 For areas subjected to vehicular traffic, the most effective laying pattern is herringbone. The orientation of the herringbone pattern in relationship to the direction of the vehicular areas does not affect the performance of the pavement. Herringbone may not be achievable with some preparatory block designs – consult the manufacturer for preferred patterns. The laying pattern shall be selected from Table 7.

Table 7. Laying patterns related to applications

Category	Typical Applications	Laying pattern
I	msa 0.5 to 12	Herringbone
II	Adopted highways and other roads less than 0.5msa, e.g. culs-de-sac, petrol station forecourts, pedestrianized areas subject to regular heavy trafficking. Car parks receiving occasional heavy traffic.	Herringbone
	Footways regularly overridden by vehicular traffic.	Any
IIIa	Pedestrianized areas receiving only occasional heavy traffic. Footways overridden by occasional vehicular traffic.	Any
IIIb	Car parks receiving no heavy traffic.	Herringbone
	Footways likely to be overridden by no more than occasional vehicular traffic.	Any
IV	Private drives, paths, patios, hard landscaping. Areas receiving pedestrian traffic only, e.g. school playgrounds	Any

8.2 For non-rectangular blocks seek advice from the manufacturer on which pattern to use.

NG9 Laying paving units

9.1 Concrete block paving units shall be placed, either mechanically or by hand, on the prepared laying course in the nominated pattern.

9.2 Use string lines to check alignment of paving blocks joint (bond) lines shall not deviate more than the values in Table 8.

Table 8. Deviation in alignment

Application	Alignment tolerance
Industrial pavements and Roadways and Highways	± 15mm in 15m
Architectural areas and Private Driveways	± 5mm in 10m

9.3 The order of laying which maintains an open face should be used.

9.4 After final compaction the surface course should conform to the surface tolerance levels

Conventional pavements

9.5 The paving should be laid with a typical joint width within the range of 2 mm to 5 mm.

Permeable paving

9.6 Blocks should be laid to maintain a void or joints as specified by the producer.

NG10 Cutting and Trimming

10.1 Cut blocks should only be incorporated at the perimeter of the pavement, at intermediate restraints and around obstacles.

10.2 Sizes smaller than one quarter of the original plan size should be avoided.

10.3 Blocks may be cut using one of the following methods:
a) block splitter
b) bench mounted water cooled power saw.

Notes:
1. Chamfers can be produced using the bench saw.
2. When rumbled blocks are cut, the cut edges shall be distressed before laying.

11.4 Blocks should be trimmed to fit after laying full paving blocks.

NG11 Jointing material

11.2 The jointing material for conventional pavements shall be as specified in Table 9.

Table 9. Grading for jointing material

Sieve size mm	**Percentage by mass passing %**
2	100
1	85 – 99
0.5	55 – 100
0.063 (fines content)	0 – 2 (BS EN 12620 fines category f_2)

NG12 Compaction

12.1 A plate compactor should be selected from Table 10 for the appropriate site category referred to in Table 3.

Table 10. Specification for compacting equipment

Site category	**Min plate area m^2**	**Min effective force per unit area of plate**	**Frequency Hz**	**Min mass kg**
I & II	0.25	75	65 - 100	200
III & IV	0.2	60	75 - 100	80

12.2 A vibrating plate compactor shall be used to bed the blocks into the laying course by making at least two passes.

12.3 Compaction should not occur within 1m of any laying face.

12.4 No areas should be left uncompacted at the completion of a day's work.

12.5 Prior to compaction all debris must be removed from the surface.

NG13 Joint filling

13.1 Prior to commencing the joint filling process ensure all the debris has been swept off the pavement surface and the following checked for compliance:

surface level tolerances	± 6mm
flatness of the pavement	10 mm under 3m straight edge
difference in levels between blocks	2mm
joint width	2mm to 5mm and consistent
joints are correctly aligned	(see Table 8)
there are no damaged or cracked blocks	

Any necessary corrective action should be taken to ensure the pavement conforms to the specification.

13.2 Jointing material shall be brushed into the joints to completely fill the joints, followed by two or more applications of the vibrating plate compactor over the surface course. Additional jointing material shall be added to top up the joint as necessary after compaction.

13.3 No joints should be left unfilled and uncompacted at the completion of a day's work, except for areas less than 1 m from an unrestrained edge.

NG14 General

14.1 The surface course should be inspected soon after completion and at regular intervals thereafter. Additional sand should be brushed in where necessary.

NG 15. References

Interpave. *Permeable Pavements – Guide to the Design, Construction and Maintenance of Concrete Block Permeable Pavements – Edition 3.* 2005.

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 EN 1338:2003 – *Concrete paving blocks – Requirements and test methods.*