BRITISH STANDARD

Pavements constructed with clay, natural stone or concrete pavers –

Part 4: Code of practice for the construction of pavements of precast concrete flags or natural stone slabs

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Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 24, an inside back cover and a back cover.

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Foreword

Publishing information

This part of BS 7533 was published by BSI and came into effect on 30 November 2006. It was prepared by Technical Committee B/507, *Paving units, kerbs, screeds and in-situ floorings.* A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 7533 supersedes BS 7533-4:1998, which is withdrawn.

Relationship with other publications

BS 7533 consists of the following parts:

- *Part 1: Guide for the structural design of heavy duty pavements constructed of clay pavers or precast concrete paving blocks;*
- *Part 2: Guide for the structural design of lightly trafficked pavements constructed of clay pavers or precast concrete paving blocks;*
- *Part 3: Code of practice for laying precast concrete paving blocks and clay pavers for flexible pavements;*
- *Part 4: Code of practice for the construction of pavements of precast concrete flags or natural stone slabs;*
- *Part 5: Guide for the design of pavements (other than structural aspects);*
- *Part 6: Code of practice for laying natural stone, precast concrete and clay kerb units;*
- *Part 7: Code of practice for the construction of pavements of natural stone setts and cobbles;*
- *Part 8: Guide for the structural design of lightly trafficked pavements of precast concrete flags and natural stone slabs;*
- *Part 9: Code of practice for the construction of rigid pavements of clay pavers;*
- *Part 10: Guide for the structural design of trafficked pavements constructed of natural stone setts;*
- *Part 11: Code of practice for the opening, maintenance and reinstatement of pavements of concrete, clay and natural stone;*
- *Part 12: Guide to the structural design of trafficked pavements constructed on a bound base using concrete paving flags and natural stone slabs.*

Use of this document

As a code of practice, this part of BS 7533 takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this part of BS 7533 is expected to be able to justify any course of action that deviates from its recommendations.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions in this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

The word "should" is used to express recommendations of this standard. The word "may" is used in the text to express permissibility, e.g. as an alternative to the primary recommendation of the clause. The word "can" is used to express possibility, e.g. a consequence of an action or an event.

Notes and commentaries are provided throughout the text of this standard. Notes give references and additional information that are important but do not form part of the recommendations. Commentaries give background information.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

1 Scope

This part of BS 7533 gives recommendations for laying precast concrete flags conforming to BS EN 1339 and natural stone slabs conforming to BS EN 1341 intended for use in the construction of carriageways, footways, pedestrian areas and pavements for rigid and flexible construction for the different application as given in Table 5 and designed in accordance with BS 7533-8 and BS 7533-12.

NOTE Guidance on the reinstatement of pavements is given in BS 7533-11.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 6100-2, *Glossary of building and civil engineering terms – Part 2: Civil engineering*

BS 7533-1:2001, *Pavements constructed with clay, natural stone or concrete pavers – Part 1: Guide for the structural design of heavy duty pavements constructed of clay pavers or precast concrete paving blocks*

BS 7533-2:2001, *Pavements constructed with clay, natural stone or concrete pavers – Part 2: Guide for the structural design of lightly trafficked pavements constructed of clay pavers or precast concrete paving blocks*

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*

BS 7533-8, *Pavements constructed with clay, natural stone or concrete pavers – Part 8: Guide for the structural design of lightly trafficked pavements of precast concrete flags and natural stone slabs*

BS 7533-11, *Pavements constructed with clay, natural stone or concrete pavers – Part 11: Code of practice for the opening, maintenance and reinstatement of pavements of concrete, clay and natural stone*

BS 7533-12, *Pavements constructed with clay, natural stone or concrete pavers – Part 12: Guide to the structural design of trafficked pavements constructed on a bound base using concrete paving flags and natural stone slabs*

BS EN 206-1, *Concrete – Part 1: Specification, performance, production and conformity*

BS EN 998-2:2003, *Specification for mortar for masonry – Part 2: Masonry mortar*

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

BS EN 1339:2003, *Concrete paving flags – Requirements and test methods*

BS EN 1341:2001, *Slabs of natural stone for external paving – Requirements and test methods*

BS EN 1342:2001, *Setts of natural stone for external paving – Requirements and test methods*

BS EN 12620:2002, *Aggregates for concrete*

BS EN 13286-49, *Unbound and hydraulically bound mixtures – Part 49: Accelerated swelling test for soil treated by lime and/or hydraulic binder*

HIGHWAYS AGENCY. *Manual of Contract Documents for Highway Works, Volume 1: Specification for Highway Works*, London: The Stationery Office

3 Terms and definitions

For the purposes of this part of BS 7533, the terms and definitions given in BS 6100-2 and the following apply.

3.1 flag
precast concrete unit, used as a surfacing material, with an overall length that does not exceed 1 m and an overall length which when divided by its thickness is greater than four

[BS EN 1339:2003, definition **3.2**]

3.2 slab
unit of natural stone used as a paving material, in which the working width exceeds 150 mm and also generally exceeds two times the thickness

[BS EN 1341:2001, definition **3.1**]

3.3 paving unit
either a precast concrete flag or natural stone slab

3.4 concrete paving block
precast concrete unit, used as a surfacing material, in which, at a distance of 50 mm from any edge, any cross-section does not show a horizontal dimension less than 50 mm and with an overall length which when divided by its thickness is less than or equal to four

NOTE These two conditions are not applicable to complementary fittings.

[BS EN 1338:2003, definition **3.2**]

3.5 natural stone sett
small natural stone paving block with work dimensions between 50 mm and 300 mm and no plan dimension generally exceeding twice the thickness. The nominal thickness is 50 mm

[BS EN 1342:2001, definition **3.1**]

3.6 surface course
layer of paving units that acts as a wearing surface and forms part of the structure of the pavement

[BS 7533-3:2005, definition **3.14**]

3.7 laying course
layer of material on which paving units are bedded

[BS 7533-1:2001, definition **3.1**]

3.8 subgrade
upper part of the soil, natural or constructed, that supports the loads transmitted by the overlaying road structure

[BS 7533-2:2001, definition **3.3**]

3.9 pavement
paved area subject to pedestrian and/or vehicular traffic

[BS 7533-2:2001, definition **3.4**]

3.10 sub-base
one or more layers of material placed immediately above the subgrade

[BS 7533-2:2001, definition **3.5**]

3.11 roadbase
one or more layers of material placed above the sub-base that constitute the main structural elements of a pavement

[BS 7533-2:2001, definition **3.6**]

3.12 sub-layer
layer below the laying course and above the subgrade which may include either or both sub-base and roadbase layers

3.13 restraint
device that serves to prevent lateral movement of the paving units and to prevent loss of the laying course material

[BS 7533-3:2005, definition **3.3**]

3.14 edge restraint
restraint used at the edges of an area being paved

[BS 7533-3:2005, definition **3.4**]

3.15 joint width
distance between two adjacent paving units or between paving units and restraint

[BS 7533-3:2005, definition **3.18**]

3.16 commercial vehicles
vehicle having an unladen weight exceeding 1.5 t

[BS 7533-1:2001, definition **3.11**]

3.17 standard axles
axles carrying a load of 8 200 kg

[BS 7533-1:2001, definition **3.11**]

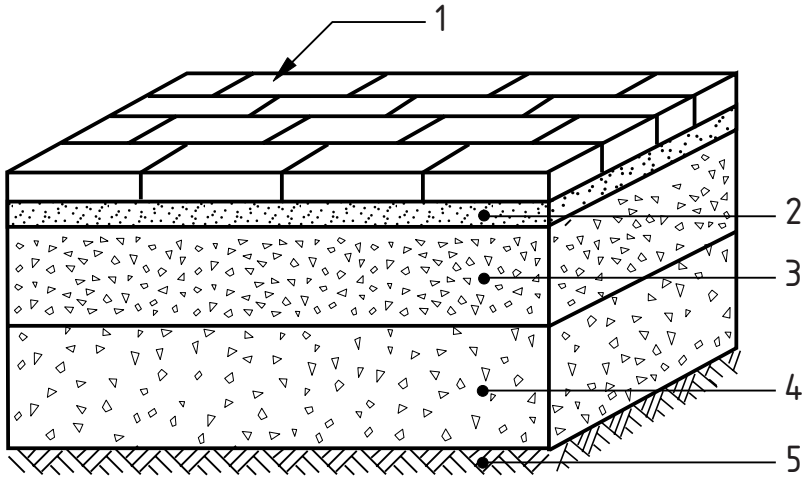
3.18 bound construction
paving units laid on and jointed with hydraulic mortar

3.19 unbound construction
paving units laid on and jointed with sand

4 Structure of pavement

A typical cross-section of a pavement is shown in Figure 1.

Figure 1 **Typical cross-section of a pavement**



Key

1 Surface course
2 Laying course
3 Roadbase/sub-base
4 Capping layer
5 Subgrade

5 Construction of pavement

NOTE The procedure for constructing a pavement is represented in a flowchart in Figure E.1. The flowchart shows a general sequence of operations that reflects the construction process.

5.1 Subgrade, sub-base and roadbase

The subgrade, sub-base and roadbase should be designed in accordance with BS 7533-8 or BS 7533-12.

Preparation of the subgrade and construction of the sub-base and roadbase should generally be in accordance with current practice as described in the Highways Agency's Specification for Highway works except for reinstatements where reference should be made to BS 7533-11.

NOTE 1 The sub-base can be used as the roadbase in an unbound pavement.

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

a) the surface levels of the sub-base and roadbase (if present) are within the tolerances given in Annex B;

b) longitudinal falls and cross falls of the completed pavement are introduced into the pavement at the subgrade level to allow the water to run off, and avoiding ponding;

NOTE 2 A minimum longitudinal fall of 1.25% and a minimum cross fall of 2.5% are recommended for carriageways using paving units as a channel. For other areas a 1% longitudinal and 1.25% cross falls are recommended and for carriageways using proprietary systems a 2.5% cross fall is recommended with a longitudinal fall as recommended by the supplier.

c) the surface of the sub-base and roadbase (if present) is tight and dense enough to prevent laying course material being lost into it during construction and use except where the pavement is used as a permeable pavement in which case alternatives should be made to prevent the loss of bedding material;

d) the extent of the site preparation includes enough room to provide adequate foundations and backing for any edge restraint.

Where the sub-base or roadbase contains hydraulic binder and is not to be covered by another pavement course within 2 h, it should be protected from moisture loss, e.g. by covering with plastic sheeting. If a curing membrane or compound is used, the manufacturer's instructions should be followed.

The appropriate minimum time given in Table 1 should be allowed to elapse before starting to lay the surface course.

Table 1 **Minimum time between finishing the sub-base/roadbase and starting the laying course surface**

Sub-base material	**Minimum time for surface course compacted with paviour's maul** [A)] h	**Minimum time for surface course compacted with a vibrating plate** [A)] h
Natural ground	0	0
Granular sub-base material type 1 or type 2	0	0
Bitumen-bound material	0	0
Hydraulically bound material categories I, II or III	0	72

[A)] This minimum time applies at ambient temperatures above 4 °C.

5.2 Restraint

5.2.1 Edge restraint

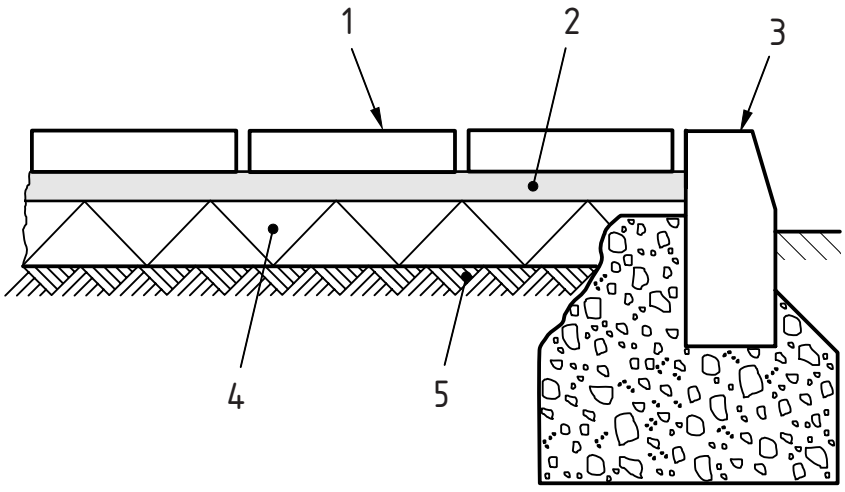
Edge restraints should be installed before the laying course and paving units are laid.

Edge restraints need to be sufficiently robust to withstand override by any anticipated traffic, to withstand thermal expansion and to prevent loss of laying course material (see Figure 2).

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

Edge restraints should be securely fixed.

Figure 2 **Typical section of pavement including edge restraint**



Key

1 Precast flag or slab
2 Laying course
3 Edge restraint
4 Sub-layer
5 Subgrade

NOTE Sub-layer can be roadbase and/or sub-base.

5.2.2 Intermediate restraint

Intermediate restraints should be used when necessary, e.g. on steep slopes.

5.2.3 Temporary restraint

Temporary restraints should be used when necessary to prevent paving units moving during construction and are particularly important if a partially completed pavement is to be trafficked or when it is necessary to preserve the integrity of the laying face at the end of the working period.

5.3 Site categories

For the purpose of selection of laying course and jointing material, pavement should be categorized according to the commercial vehicular assessment shown in Table 2.

Table 2 **Applications and laying course material**

Site category	Standard axles per day	Typical applications	Clause reference
I	<200	Adopted highways and commercial developments used by a high number of commercial vehicles	**5.4.4**
II	⩽60	Adopted highways and other roads used by a moderate number of commercial vehicles Petrol station forecourts Pedestrian projects subjected to regular overrun of commercial vehicles	**5.4.4** or **5.4.6**
III	⩽5	Adopted highways and other roads used by a low number of commercial vehicles, e.g. cul-de-sac on a housing development Pedestrian projects subjected to occasional overrun of commercial vehicles Car parks receiving occasional commercial vehicular traffic Footways overridden by commercial vehicular traffic	**5.4.4** or **5.4.6**
IV	0	Car parks receiving no commercial vehicular traffic Footways subjected to domestic vehicular crossover Private drives, paths, patios, hard landscaping Areas receiving pedestrian traffic only, e.g. school playgrounds	**5.4.4, 5.4.5** or **5.4.6**

5.4 Installation of surface course for different site categories

5.4.1 General

Paving units should be placed on the prepared laying course in the nominated pattern. Any minor adjustments necessary to maintain the laying pattern should then be made.

NOTE 1 A string line may be used to check the alignment of the paving units.

The paving units should be laid in such a way that, after final compaction, the surface course should conform to the surface level tolerances and surface regularity given in Annex B.

NOTE 2 Full support to the paving units is necessary, i.e. a full bed of either mortar or sand. If the pavement is a permeable pavement then include mortar/sand or other suitable material to ensure no surface deformation under imposed loads.

An order of laying which maintains an open laying face should be followed. The alignment of paving units should be checked periodically for all laying patterns, e.g. by using string lines, and adjustments made where necessary.

NOTE 3 A flow chart of the general process of construction is given in Annex E.

NOTE 4 It is difficult to achieve straight lines when laying paving units because the straightness is dependent on the workmanship of the person laying the units and the differences in sizes of the paving units that result from the manufacturer's accepted tolerance levels.

On slopes paving units should be laid commencing from the bottom working upwards whenever possible.

When laying on sand laying course material work off the paving units and when laying using hydraulic mortar work off the hardened base.

5.4.2 Laying pattern

Paving units should be bonded.

NOTE 1 The laying pattern is chosen, not only for appearance, but also as a means of resisting the effects of vehicular traffic, whether travelling in straight lines or turning.

NOTE 2 For pedestrian-only areas, the laying pattern is not as important to serviceability.

NOTE 3 Where concrete paving blocks and small stone setts are used to form the bond between paving units, their differing dimensions and tolerances can require the use of wider joints.

5.4.3 Joint filling

The joints between paving units should be filled.

Prior to applying any jointing material, the surface should be free of debris.

Prior to sand joint filling or mortar joint filling the paving surface should be checked so that:

a) the surface level tolerance conforms to Annex B;

b) the flatness of the pavement conforms to Annex B;

c) the difference in level at the joint of adjacent paving units conform to Annex B;

d) joint width is consistent;

e) joints are correctly aligned;

f) there are no damaged or broken units.

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

5.4.4 Bound construction – laying paving units on mortar for all site categories

5.4.4.1 General

The surface of the hydraulically bound material (HBM) should be swept and washed with water to ensure it is free from dust, loose material and debris.

The top surface of this base should be primed using a suitable fine mortar slurry or proprietary bonding coat material to a thickness of 1 mm to 2 mm immediately prior to the placement of the bedding mortar upon it. The priming slurry should be fresh and wet when the bedding mortar is spread out upon it.

NOTE Priming slurry is not essential in category IV.

5.4.4.2 Laying course material

A mortar (slump 150 mm) is spread out over the surface to a depth of approximately 30 mm. It should have the properties described in Table 3 when used in conjunction with fine mortar slurry.

Table 3 **Laying course material recommendations**

Properties	Recommendations
Minimum compressive strength [A)]	30 MPa
Minimum adhesive strength [B)]	2.0 MPa
Modulus of elasticity [C)]	(18 000 ± 3 500) MPa
Maximum density [A)]	2 000 kg/m^3
Maximum shrinkage [D)]	0.15%

[A)] Measured in accordance with BS EN 1015-11.
[B)] Measured in accordance with BS EN 1015-12.
[C)] Measured in accordance with DIN 18555-6.
[D)] Measured in accordance with BS EN 445:1997, **3.4.3**.

NOTE Compressive strength is determined on site produced samples and all other tests are undertaken in the laboratory.

Paving units should be cleaned to remove dust, loose material and packaging or production aids such as paper by brushing and washing with water. The backs of the units should be primed using a suitable fine mortar slurry to a thickness of 1 mm to 2 mm immediately prior to their placement upon the bedding mortar. The priming slurry should be fresh and wet when the units are placed upon the bedding mortar. The units should be laid directly onto the bedding mortar with joint widths of 6 mm to 10 mm.

5.4.4.3 Compaction of paving units

Paving units should be laid to line and level on a full bedding layer compacted down using a paviour's maul. The units should not rock after bedding. Any rocking flags should be lifted and re-laid as necessary.

5.4.4.4 Joint and void filling material

Paving units should be laid with a joint width typically within the range of 6 mm to 10 mm.

NOTE The paving unit shape and the laying pattern will influence the joint width.

The width of the joint should not include the chamfer dimension (if any).

The joint material for paving units laid using laying course material in accordance with this clause should have the properties given in Table 4.

Table 4 **Jointing material recommendations**

Properties	Recommendations
Minimum compressive strength [A)]	40 MPa
Minimum adhesive strength [B)]	1.5 MPa
Modulus of elasticity [C)]	(20 000 ± 4 000) MPa
Minimum density [A)]	2 000 kg/m^3
Maximum shrinkage [D)]	0.15%

[A)] Measured in accordance with BS EN 1015-11.
[B)] Measured in accordance with BS EN 1015-12.
[C)] Measured in accordance with DIN 18555-6.
[D)] Measured in accordance with BS EN 445.

After the initial set of the laying course mortar (approximately 12 hours), the whole surface of the laid paving should be thoroughly wetted with clean water and jointing material in slurry form should be either:

a) spread over the entire surface and moved towards open joints; or

b) gunned in or poured in by watering can.

A quantity of mortar slurry should be allowed to remain on the surface and should be moved across the surface a minimum of two times in order to top up joints in which the mortar has slumped excessively. During this time the mortar should be maintained in a wet condition by the application of a spray of water.

The surface should be sprayed or wetted with more water and a squeegee should be used to remove any excess mortar from the surface of the paving units, moving any excess material towards open joints. This process should be repeated until all the jointing material is cleaned off the surface of the paving units.

Mortar bedding and joints should be allowed to harden before allowing access to the surface and the area should not be opened to vehicular traffic for approximately seven days.

5.4.5 Bound construction – laying paving units on mortar in site category IV

5.4.5.1 Laying course materials

Laying course material should consist of a workable mix of mortar conforming to BS EN 998-2:2003, Table 1, designation M12.

NOTE 1 M12 uses 1:3 cement-sand mortar (proportions by volume), using fine aggregate conforming to BS EN 12620:2002 G_F85 0/4 (MP).

The laying course material should be laid to give a thickness between 15 mm and 25 mm after compaction.

Where mortar has begun to set it should be replaced with fresh mortar.

NOTE 2 Retarded, plasticized and premixed mortars may be used.

5.4.5.2 Joint construction using mortar

Paving units should be laid with a joint width typically within the range of 6 mm to 10 mm.

NOTE 1 The paving unit shape and the laying pattern will influence the joint width.

The width of the joint should not include the chamfer dimension (if any).

Paving units should have their joints filled to the full depth of the unit and to within 2 mm to 3 mm of their top surface. Mortar conforming to BS EN 998-2:2003, Table NA.1, designation M6 should be used.

NOTE 2 M6 uses.1:4 cement-sand mortar (proportions by volume) using fine aggregate conforming to BS EN 12620:2002 G_F85 0/1 (MP).

The mortar should be:

a) firmly pressed into the joints with a trowel or suitable rod;

b) spread on the side of the laid paving unit, offer the next paving unit to this and strike off any surplus mortar.

Any mortar on the surface should be cleaned off immediately to avoid staining if this is an important consideration.

5.4.5.3 Compaction of paving units

Paving units should be laid to line and level on a full bedding layer compacted down using a paviour's maul. The units should not rock after bedding. Any rocking flags should be lifted and re-laid as necessary.

5.4.6 Unbound construction – laying paving units on an aggregate laying course in site categories II, III and IV

5.4.6.1 General

The laying course should be laid on the roadbase or, if there is no roadbase, the sub-base.

The laying course material should not be used as a regulating course or used to achieve falls.

The thickness of the laying course after final compaction of the surface course should be 25 mm, with a surface level tolerance conforming to Annex B.

NOTE 1 If the tolerances given in Annex B are exceeded, this can affect the performance of the pavement.

One of the following methods of screeding the laying course should be used for concrete paving or natural stone slabs:

a) Spread the material in one layer and compact this layer using a plate compactor and then the top 10 mm should be loosened using a rake.

b) Alternatively, 25 mm of laying course material should be screeded out, compacted and then a further 10 mm of loose material screeded out.

In order to achieve the target laying course thickness, allowances should be made for the reduction in thickness achieved during compaction. The surface should be levelled by screeding. In areas of mixed paving, i.e. flags and blocks, the flags should determine the thickness of the laying course.

NOTE 2 Vibrating plate compactors as described in Annex D have been found suitable for compacting the laying course.

NOTE 3 The laying course may be placed and screeded using a mechanical device such as an asphalt laying machine.

NOTE 4 Where previous experience of a particular laying course material is lacking, a small trial area should be constructed in order to determine the amount of material surcharge that will be needed to compensate for the decrease in thickness that happens as a result of all the compactions that occur in the construction of the pavement.

Any disturbance of the laying course material that will adversely effect the laying of paving units should be corrected.

After the careful removal of the screeding rails, the disturbed area should be filled and re-screeded with laying course material.

The area of laying course prepared should generally be such that at the end of a working day, its boundary is not less than 1 m ahead of the laying face.

All areas of prepared laying course material should be protected and not left exposed overnight.

5.4.6.2 Laying course material

The laying course should contain no material which could detract from the unbound nature of the laying course, e.g. cement or lime. The laying course material should be naturally occurring sand from the quaternary geological series or sea-dredged sands and should conform to Table 5.

NOTE Recycled aggregate may be used as laying course material provided it can be shown to have a performance that is comparable to naturally occurring sand.

Table 5 **Laying course material grading (BS EN 12620:2002 G_F 85 0/4 (MP) fine aggregate)**

Sieve size mm	**Percentage by mass passing** %
8	100
6.3	95–100
4	85–99
0.5	30–70
0.063	0–3

5.4.6.3 Moisture content

When preparing the laying course, the material should be moist without being saturated. It should show no free water and should bind together when the material is squeezed in the hand and the pressure released.

If the prepared laying course becomes saturated prior to laying the paving units, it may be removed and replaced, or allowed to dry to an acceptable moisture content. To control the moisture content of a stockpile, covers may be used.

5.4.6.4 Joint construction using sand

Paving units should be laid with a joint width typically within the range of 2 mm to 5 mm. The paving unit shape and the laying pattern will influence the joint width. The width of the joint should not include the chamfer dimension (if any).

NOTE The use of purpose-made spacer units can minimize contact during compaction.

The joint filling material should be dried free-flowing silica sand conforming to Table 6.

Table 6 **Jointing material grading (BS EN 12620:2002 G_F 85 0/4 (MP) fine aggregate)**

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)

Material that might stain the pavement surfaces should not be used.

5.4.6.5 Compaction of paving units

5.4.6.5.1 General

Prior to compaction, the surface should be free of debris. The joints between paving units should be filled.

A vibrating plate compactor (see Annex D), should be used to fully bed the paving units into the laying course making two or more passes.

A small amount of jointing material conforming to Table 6 should be applied to assist in maintaining units in their correct position before compaction.

The compaction should be carried out as soon as possible after the laying of the paving units.

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

It is advisable that all areas of paving, other than an area within 1 m of a laying face, should not be left uncompacted at the completion of the day's work.

5.5 Cutting and trimming

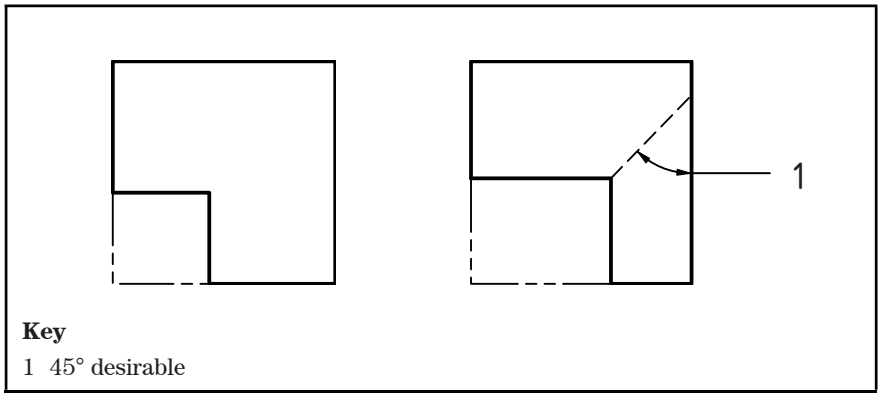
5.5.1 General

Where paving units need to be cut or trimmed, sizes smaller than a quarter of the original plan size of the unit should be avoided. To avoid cutting paving units to smaller than a quarter of their original size, complementary fittings and inboard cutting should be used to complete the surface course.

NOTE 1 Paving units can be cut using a bench mounted water-cooled power saw.

Wherever possible, cutting paving units should be avoided, e.g. by using other sizes of the same thickness. If more than 25% of the paving unit has to be notched, the remaining shape (from the internal corner of the cut-out to the external corner of the paving units) should be cut as shown in Figure 3.

Figure 3 **Typical ways of cutting flags**



Key
1 45° desirable

The accuracy of cutting the unit should be such that the joint between the cut unit and the full unit or the edge restraint should be consistent with the overall joint design.

NOTE 2 Against curved edges, it might not always be possible to maintain the joint consistent with the overall joint design.

NOTE 3 Paving units and complementary fittings might be available to assist with the formation of boundaries and with changes in direction.

5.6 Trimming and laying around obstructions

The paving units should be trimmed to fit after laying full paving units around any obstruction. The joints between the obstruction and the paving units should be consistent with the overall joint design.

NOTE It is not recommended to use mortar to infill small gaps in an unbound system.

Where it is necessary to use infill around an obstruction, one of the following materials should be used for the infill:

a) A C35 air entrained concrete conforming to BS EN 206-1, or

b) A 3:1 mix of BS EN 12620:2002 G85/20 6.3/14 coarse aggregate (or any BS EN 12620 aggregate that is a maximum of a quarter of the size of the gap being filled) and mortar conforming to **5.4.4.2**.

For joints being slurry grouted, the void should be filled with clean coarse aggregate in the range 2.5 mm to 5.0 mm. The grout should be allowed to fill the void.

6 Construction in adverse weather conditions

6.1 Bound laying construction

Units should not be laid when the ambient temperature is 2 °C and is falling.

6.2 Unbound laying construction

In adverse weather conditions, units should not be laid on saturated laying course material.

NOTE The filling of sand joints is not possible in damp conditions.

In such conditions, the joints should be topped up at the earliest opportunity.

7 Additional work after early trafficking

7.1 General – unbound construction

The surface course should be inspected soon after completion and at regular intervals thereafter. Additional jointing material should be brushed in where necessary for unbound construction.

In time, detritus will accumulate in the joints tending to seal them; until this has occurred, the paving should only be brushed by hand. Mechanical sweepers, in particularly sweepers with high suction forces, should not be used or used only with care in order to avoid the risk of losing the jointing material from between the paving units, thus adversely affecting the performance of the pavement.

NOTE When the unbound paving with sand jointing material needs to be stabilized, surface-applied elastomeric sealers may be applied in strict accordance with the manufacturer's instructions. This treatment impedes the unwanted removal of the jointing material by suction cleaners and at the same time reduces the ingress of water during the early life of the pavement. This treatment might have an effect on the colour of the paving unit and its initial slip/skid resistance and could require further applications after a period of time depending on the nature and usage of the pavement.

Annex A (informative)

Recommended typical pavement layouts for vehicle crossings

NOTE Figures A.1 to A.6 are for illustration purposes only and are not to scale.

A.1 A ramped car crossing is formed where the footpath and driveway are at similar levels. The kerbs should be placed into the required position and the adjacent paving units ramped to the footpath level. The two corner paving units should be cut diagonally to form a mitred ramp (see Figure A.1).

Ramps should not be steeper than 1:10.

A.2 Dropped pedestrian crossings are formed when the footway crosses the carriageway. The kerbs should be placed into the required position and the two lines of paving units adjacent to the dropped kerbs should be ramped from the footway to the top of the dropped kerb (see Figure A.2).

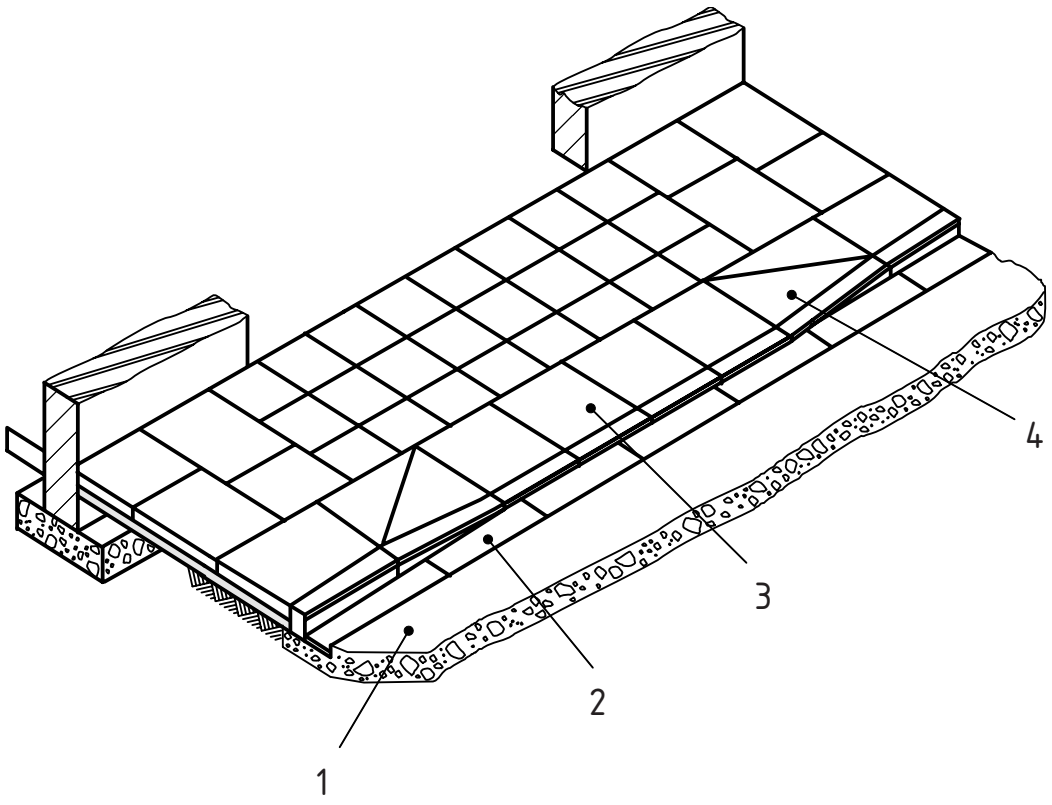
A.3 Small element paving units can be used for vehicle crossings and in areas where footways may be subjected to over-run by vehicles.

A.4 Radial paving at the intersection of footways and footpaths may be carried out in a number of ways. Two examples are described as follows.

a) *Runout corner*. The laying pattern of the major footways continues through the corner, with the paving units abutting the radial kerb marked and cut to fit. The paving units on the minor footway may abut the inner edge of the major footpath (see Figure A.3).

b) *New town corner*. This can be used with either equal or unequal width footways but the inner edges of the footways may be connected with a straight line from the start points of the curves. The paving units are laid from this line. The outer paving units are cut to meet the curved kerbs and marked using a template (see Figure A.4).

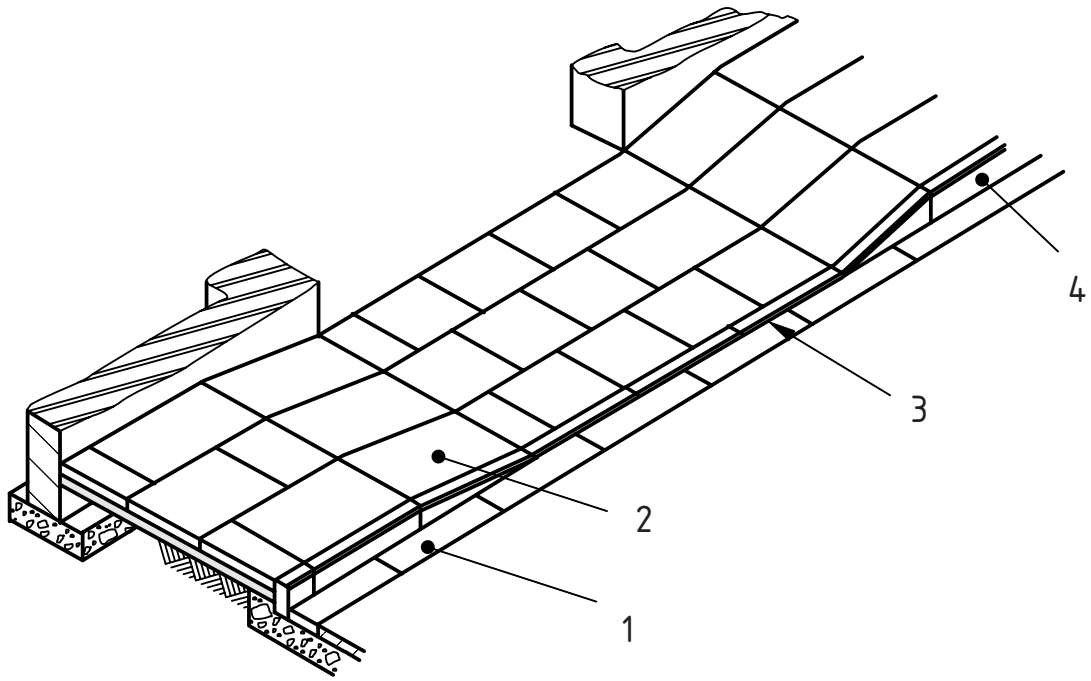
Figure A.1 **Example of a ramped crossing**



Key

1 Road surface
2 Channel
3 Flags or slabs ramped
4 Flags or slabs cut across for mitre and ramp

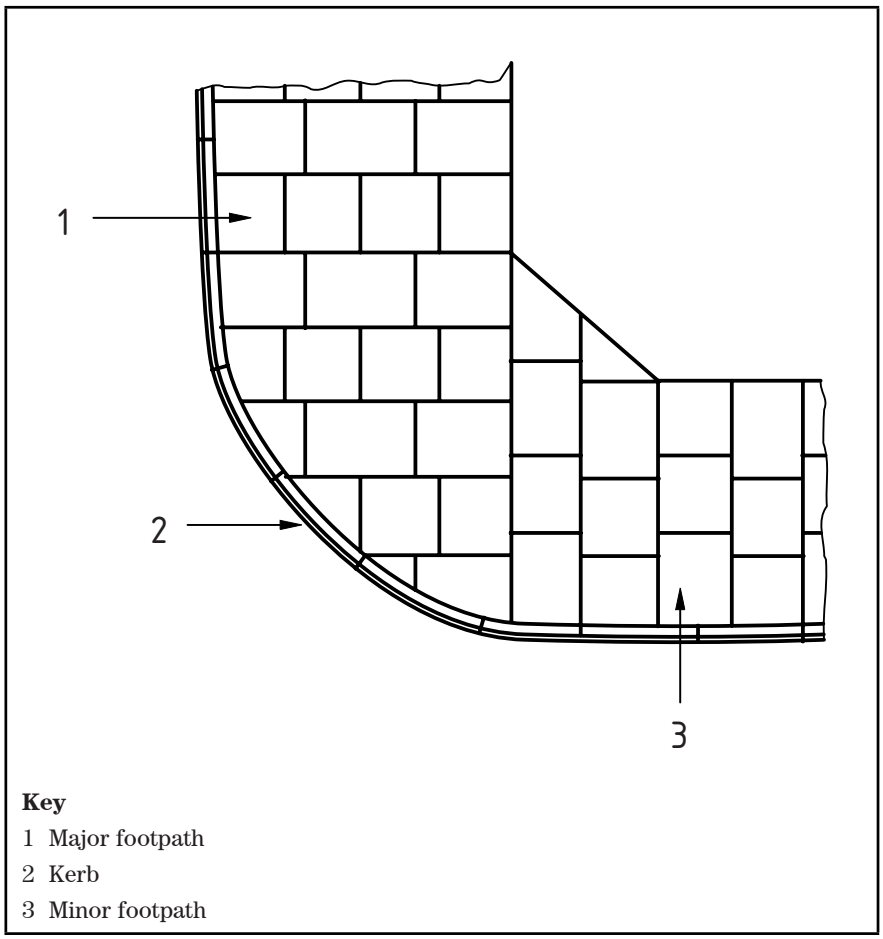
Figure A.2 **Example of a dropped crossing**



Key

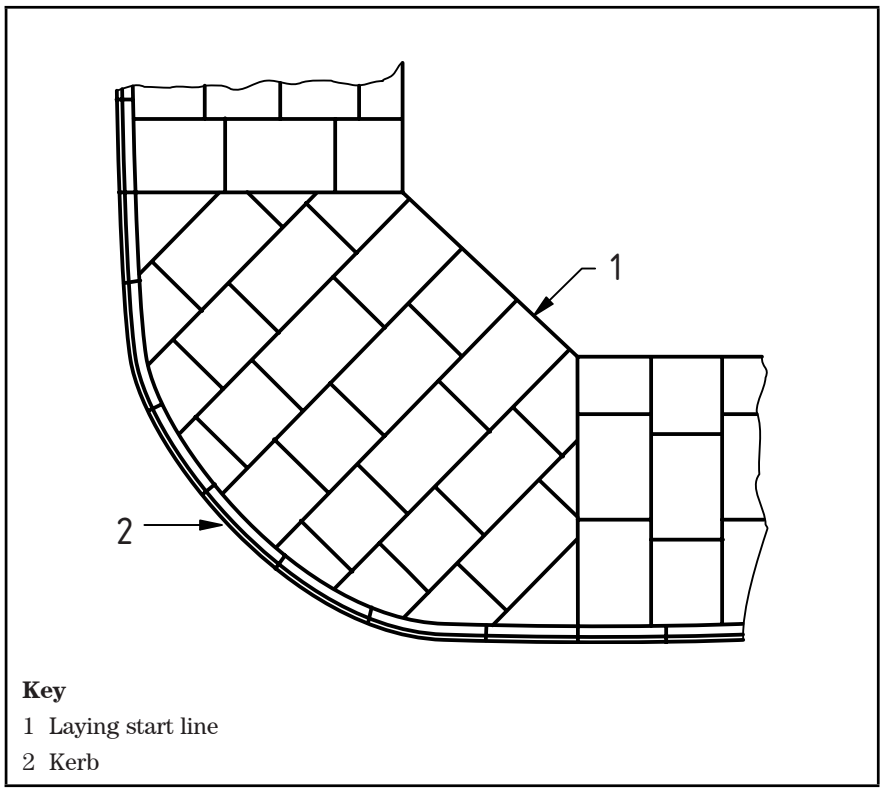
1 Channel
2 Ramp flags and slabs
3 Dropped crossing
4 Kerb

Figure A.3 **Example of a runout corner**



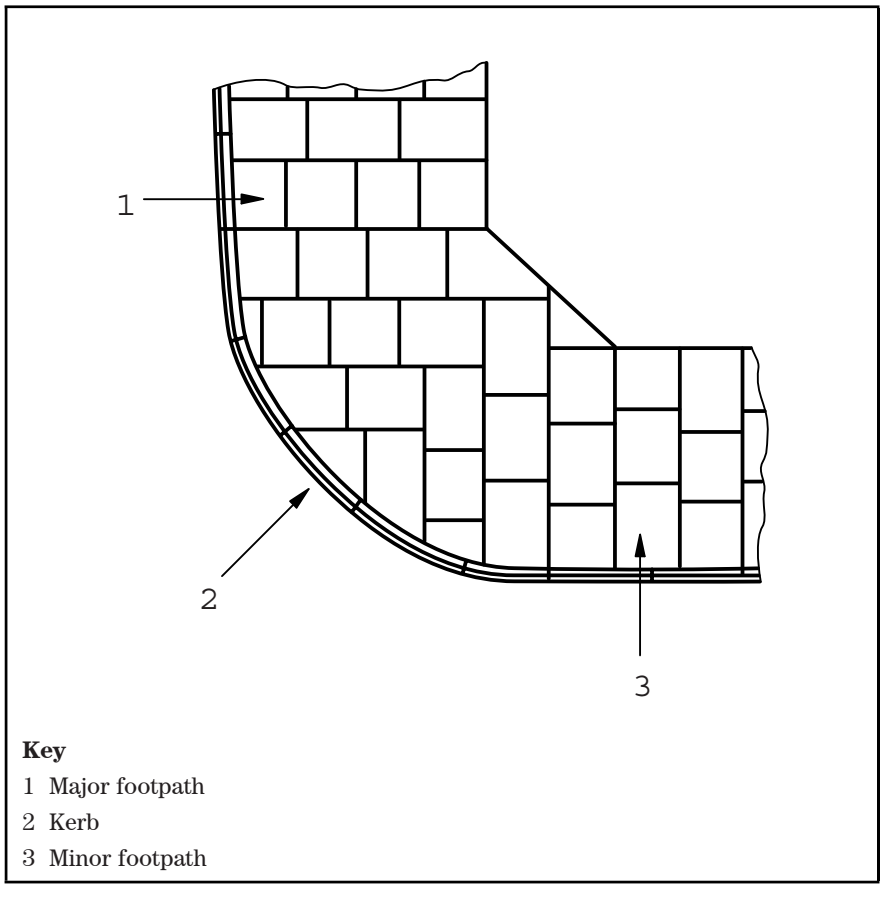
Key
1 Major footpath
2 Kerb
3 Minor footpath

Figure A.4 **Example of a new town corner**



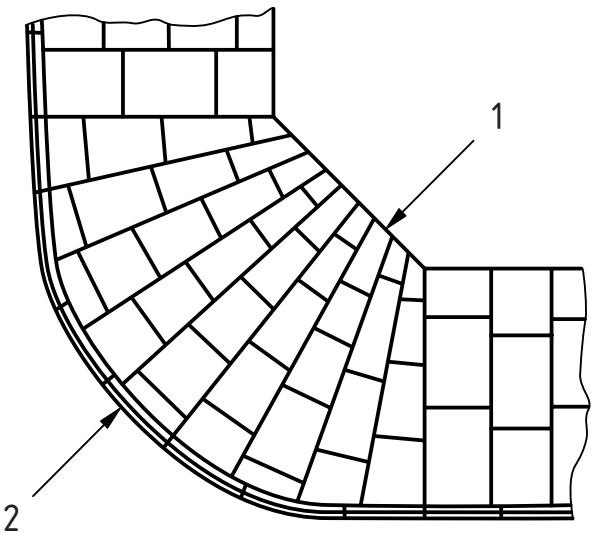
Key
1 Laying start line
2 Kerb

Figure A.5 **Example of a bonded corner**



Key
1 Major footpath
2 Kerb
3 Minor footpath

Figure A.6 **Example of a splayed corner**



Key
1 Laying start line
2 Kerb

Annex B (normative) Maximum permissible deviations on surface levels

Table B.1 **Tolerance of surface levels**

Layers of pavement	**Maximum permissible deviation from the design level** mm
Sub-base	$^{+5}_{-10}$
Roadbase	$^{+5}_{-10}$
Laying course	$^{+5}_{-10}$
Surface course	$^{+6}_{-6}$

Table B.2 **Surface regularity of the surface course**

Measurement of surface regularity	**Tolerances**
Flatness of pavements when laid	3 mm under 3 m straight edge
Differences in levels at the joint of adjacent paving units	2 mm
NOTE When laying riven face units the above tolerances do not apply.	

Annex C (informative) Compaction equipment for base compaction

Table C.1 **Recommended compaction equipment for base compaction**

Type of compaction plant	Mass	Minimum number of passes for compacted layer thickness	
		100 mm	150 mm
Vibrating plate	1 400 kg/m^2 to 1 800 kg/m^2 [A)]	6	Not suitable
	1 800 kg/m^2 to 2 100 kg/m^2 [A)]	4	8
Vibrating roller	700 kg/m to 1 300 kg/m [B)]	12	Not suitable
	1 300 kg/m to 1 800 kg/m [B)]	5	12
Engine driven vibro-tamper	50 kg to 65 kg	4	8
	65 kg to 75 kg	3	3
	Over 75 kg	2	2

[A)] Unit area beneath the base plate.
[B)] Unit width of roller.

Annex D (informative) Compaction equipment for compacting surface layer

A plate vibrator with the following specification should be used:

a) plate area of not less than 0.25 m^2 or dimensions greater than those of an individual flag;

b) effective force transmission rate of not less than 75 kN/m^2 of plate;

c) vibration frequency in the range 65 Hz to 100 Hz;

d) minimum mass of 200 kg.

NOTE 1 Some manufacturers recommend the use of a vibrator with a neoprene sole plate to protect special surfaces.

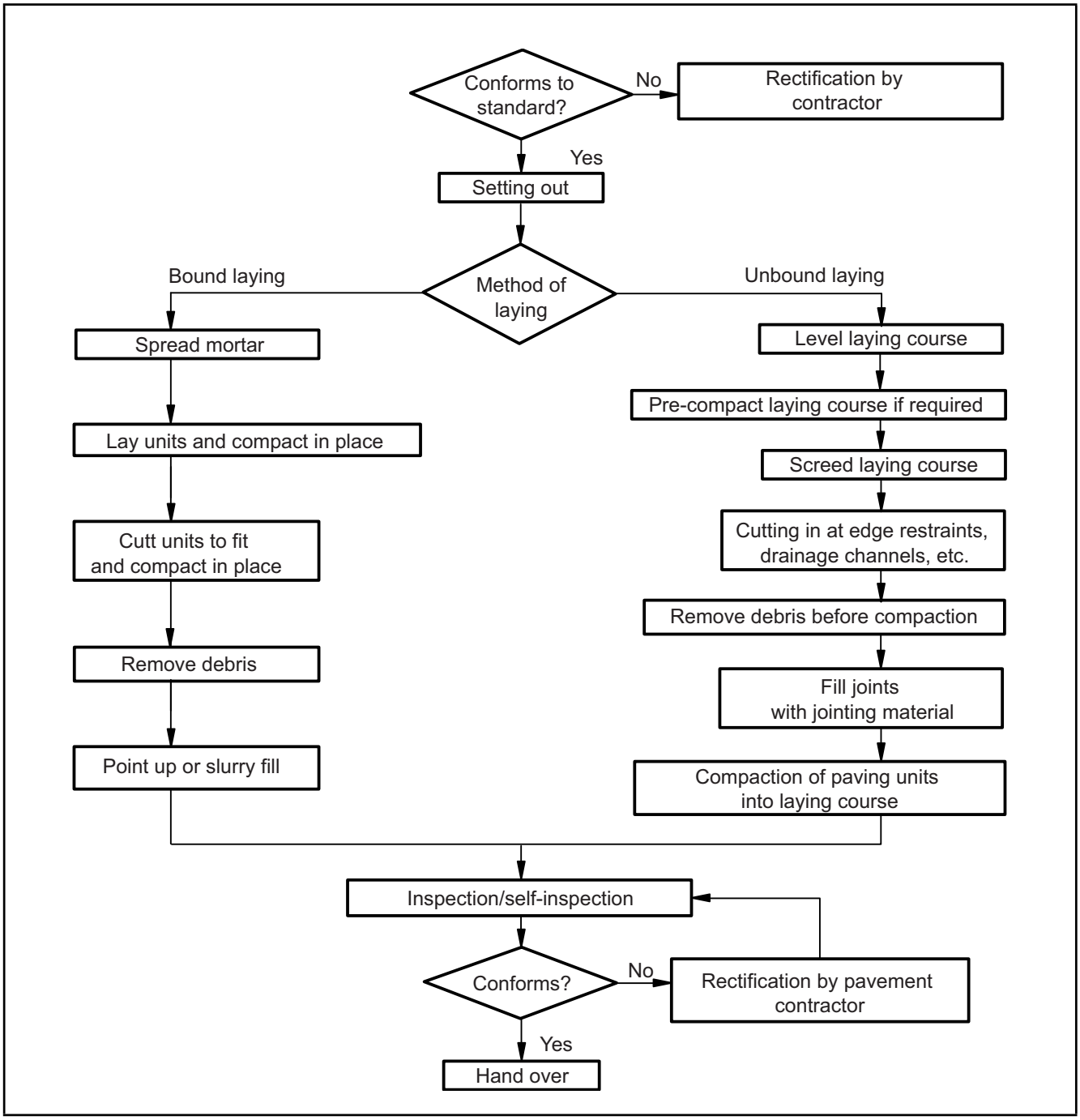
NOTE 2 Care should be taken to fill voids left in the laying course by screed rails.

If any disturbance of the prepared laying course by pedestrian or wheeled traffic, etc., occurs prior to placing paving units, the area affected should be re-laid.

NOTE 3 Typical examples of layouts using the products described in this British Standard and guidance on laying details are given in Annex A.

Annex E (informative) Flow chart of the general process of construction

Figure E.1 **General process of construction**



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