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Pavements constructed with clay, concrete or natural stone paving units

Part 102: Installation of pavements using modular paving
units – Code of practice

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Summary of pages

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Foreword

Publishing information

This part of [BS 7533](#) is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 March 2025. It was prepared by Technical Committee B/507, *Paving units and kerbs*. A list of organizations represented on this committee can be obtained on request to the committee manager.

Supersession

This document supersedes [BS 7533-3:2005+A1:2009](#), [BS 7533-4:2006](#), [BS 7533-9:2010](#) and [BS 7533-11:2003](#), which are withdrawn. This part of BS 7533 also partially supersedes [BS 7533-6:1999](#) and [BS 7533-7:2010](#).

Relationship with other publications

[BS 7533](#) is published in the following parts:

- Part 101: *Code of practice for the structural design of pavements using modular paving units*;
- Part 13: *Guide for the design of permeable pavements constructed with concrete paving blocks and flags, natural stone slabs and setts and clay pavers*; and
- Part 102: *Installation of pavements using modular paving units – Code of practice*.

Information about this document

A revision of the [BS 7533](#) series has been undertaken, in which the principal change is to reduce the number of relevant standards to three codes of practice (see “Relationship with other publications”).

The principal changes in respect of the content of BS 7533-102 are:

- the combination into BS 7533-102 of all the information on the installation of bound and unbound pavements, using concrete, clay and natural stone paving units from the following parts of the old series:
 - 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 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 paving units and cobbles, and rigid construction with concrete block paving*;
 - Part 9: *Code of practice for the construction of rigid pavements of clay pavers*;
 - Part 11: *Code of practice for the opening, maintenance and reinstatement of pavements of concrete, clay and natural stone*;
- the removal of repetition between the parts of [BS 7533](#) listed above;
- some updating of references and test methods; and
- clarification and removal of ambiguities and anomalies.

This publication can be withdrawn, revised, partially superseded or superseded. Information regarding the status of this publication can be found in the Standards Catalogue on the BSI website at knowledge.bsigroup.com, or by contacting the Customer Services team.

Where websites and webpages have been cited, they are provided for ease of reference and are correct at the time of publication. The location of a webpage or website, or its contents, cannot be guaranteed.

Hazard warnings

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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.

Users may substitute any of the recommendations in this British Standard with practices of equivalent or better outcome. Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

Presentational conventions

The provisions of this document 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.

Where words have alternative spellings, the preferred spelling of the *Shorter Oxford English Dictionary* is used (e.g. “organization” rather than “organisation”).

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1 Scope

This part of [BS 7533](#) gives recommendations and guidance for the installation of pavements having bound and unbound surface construction designed in accordance with [BS 7533-101:2021](#) and using:

- concrete paving blocks conforming to [BS EN 1338:2003](#);
- concrete paving flags conforming to [BS EN 1339:2003](#);
- concrete kerb units conforming to [BS EN 1340:2003](#);
- natural stone slabs conforming to [BS EN 1341](#);
- natural stone setts conforming to [BS EN 1342](#);
- kerbs of natural stone conforming to [BS EN 1343](#);
- clay paving units conforming to [BS EN 1344:2013](#); and
- porcelain paving slabs.

It applies to combined drainage and kerb products, and linear drainage units.

It applies to paved areas subjected to all categories of static and vehicular loading and pedestrian traffic, including domestic applications.

It gives recommendations and guidance on:

- all layers above the formation, including capping, sub-base, base, bedding and surface layers; and
- on the opening, reinstatement and cleaning of surfaces paved with modular paving units.

It also gives recommendations for the construction of a pavement using paving units in traffic categories 3 and below, where a design produced in accordance with [BS 7533-101:2021](#) has not been provided.

It is not applicable to other applications such as aircraft pavements and those in ports and specialized industrial areas.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions, or limits the application, of this document.¹⁾ For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Standards publications

[BS 7533-101:2021](#), *Pavements constructed with clay, concrete or natural stone paving units – Part 101: Code of practice for the structural design of pavements using modular paving units*

[BS 8102:2022](#), *Protection of below ground structures against water ingress – Code of practice*

[BS 8300-1](#), *Design of an accessible and inclusive built environment – Part 1: External environment – Code of practice*

[BS 8300-2](#), *Design of an accessible and inclusive built environment – Part 2: Buildings – Code of practice*

[BS EN 933-3](#), *Tests for geometrical properties of aggregates – Part 3: Determination of particle shape – Flakiness index*

[BS EN 1097-2](#), *Tests for mechanical and physical properties of aggregates – Part 2: Methods for the determination of resistance to fragmentation*

[BS EN 1338:2003](#), *Concrete paving blocks – Requirements and test methods*

¹⁾ Documents that are referred to solely in an informative manner are listed in the Bibliography.

- BS EN 1339:2003, *Concrete paving flags – Requirements and test methods*
- BS EN 1340:2003, *Concrete kerb units – Requirements and test methods*
- BS EN 1341, *Slabs of natural stone for external paving – Requirements and test methods*
- BS EN 1342, *Setts of natural stone for external paving – Requirements and test methods*
- BS EN 1343, *Kerbs of natural stone for external paving – Requirements and test methods*
- BS EN 1344:2013, *Clay pavers – Requirements and test methods*
- BS EN 12350-2, *Testing fresh concrete – Part 2: Slump test*
- BS EN 12372, *Natural stone test methods – Determination of flexural strength under concentrated load*
- BS EN 12620:2013 (withdrawn), *Aggregates for concrete*
- BS EN 13108-1, *Bituminous mixtures – Material specifications – Part 1: Asphalt Concrete*
- BS EN 13242:2013 (withdrawn), *Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction*
- BS EN 13755, *Natural stone test methods – Determination of water absorption at atmospheric pressure*
- BS EN 13877-1, *Concrete pavements – Part 1: Materials*
- BS EN 13877-3, *Concrete pavements – Part 3: Specifications for dowels to be used in concrete pavements*
- BS EN 13892-2, *Methods of test for screed materials – Part 2: Determination of flexural and compressive strength*
- BS EN 14157:2017, *Natural stone test methods – Determination of the abrasion resistance*
- BS EN 14227-1:2013, *Hydraulically bound mixtures – Specifications – Part 1: Cement bound granular mixtures*
- PD CEN/TS 15209, *Tactile paving surface indicators produced from concrete, clay and stone*

Other publications

- [N1] DEPARTMENT FOR TRANSPORT. *Specification for the Reinstatement of Openings in Highways*. Fourth edition. London: The Stationery Office, 2020.²⁾
- [N2] NATIONAL HIGHWAYS. *Manual of contract documents for highway works – Volume 1: Specification for highway works*. London: Highways Agency.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1 aspect ratio

ratio between length and width

NOTE For example, a ratio of 2:1 means the length is twice the width.

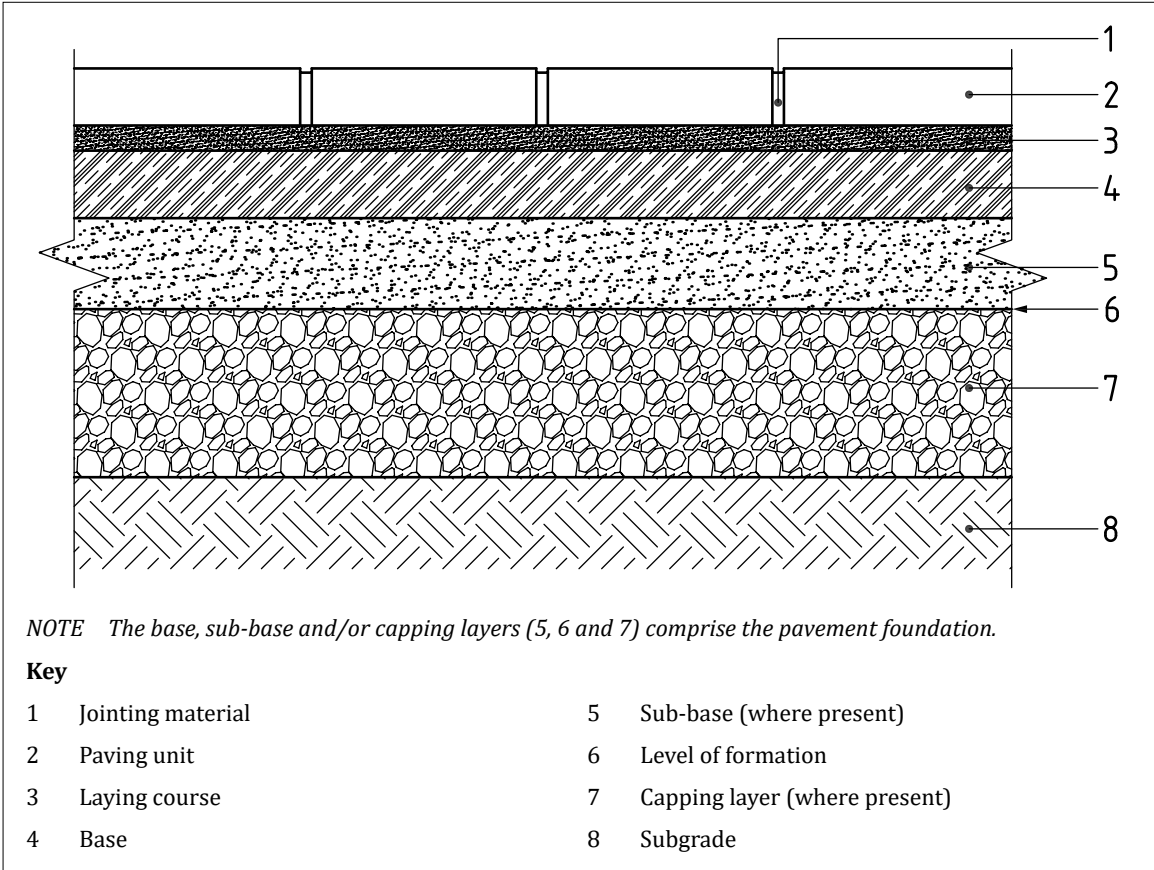
3.1.2 base

one or more layers of material placed above the sub-base that constitute the main structural element of a pavement on which the laying course is placed

NOTE This has sometimes previously been referred to as “road base”. See [Figure 1](#) for an illustration.

²⁾ Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/977196/specification-for-the-reinstatement-of-openings-in-highways-fourth-edition.pdf.

Figure 1 — Pavement layers



3.1.3 bedding mortar

blend of fine aggregate and binder upon which paving units are laid

3.1.4 binder

medium, either cementitious or bituminous, used in a mortar or concrete to bind aggregate particles together

3.1.5 bishop’s mitre

complementary paving unit having five sides, placed at the end of a row of paving units where that row forms an angle of typically 45° to the pavement edge

NOTE See Annex A, Figure A.3 for examples.

3.1.6 bound construction

paving units laid on and jointed with mortar

NOTE 1 This is irrespective of the base material, which can be bound or unbound.

NOTE 2 This has often previously been referred to as “rigid construction”.

3.1.7 bound surface construction

surface course where the paving units are laid on a laying course of bedding mortar and the joints are filled with a mortar or grout

3.1.8 capping layer

layer of granular or treated material at the top of the subgrade to improve foundation

NOTE See Figure 1 for an illustration.

3.1.9 cement bound granular material (CBGM)

granular material to which cement has been added

3.1.10 clay paving unit

fired clay unit used as a surfacing material

NOTE Requirements for clay paving units are specified in [BS EN 1344:2013](#).

3.1.11 coarse graded aggregate (CGA)

aggregate having a particle size grading typically between 4 mm and 20 mm

3.1.12 cobble

natural stone element rounded by erosion

3.1.13 commercial vehicle

bus or goods vehicle more than 3 500 kg and less than 7 500 kg gross weight

3.1.14 complementary paving unit

paving unit or part of a paving unit, of a different size to the main works, used to infill and enable an area to be fully surfaced or to enable the offset of a pattern at the end of a row

3.1.15 concrete paving block

precast concrete unit used as a surfacing material

NOTE Requirements for concrete paving blocks are specified in [BS EN 1338:2003](#).

3.1.16 creep

horizontal movement of paving units resulting from the persistent action of deceleration, cornering forces or gravity

3.1.17 design and build

project delivery system in which design and construction services are contracted by a single entity, typically a design and build contractor, from whom the client can seek legal remedies for any fault

3.1.18 drainage fitting

ironwork, plastic, clay or concrete gulley, linear drain or similar collection point where surface water flows into a drainage system and is removed from the pavement surface by gravity

3.1.19 edge beam

hardened concrete onto which kerbs/channels are laid using a mortar bed

NOTE This might be an extension of a pavement base course.

3.1.20 efflorescence

deposit on the surface of paving materials, usually white in colour, produced by the migration of salts to the surface giving the appearance of “fading” of the product colour, or staining

NOTE These salts are either from the product's natural internal chemical composition or transported through moisture movement from an external source. The resulting coating generally disappears with time and does not indicate any product defect.

3.1.21 flag

precast concrete unit used as a surfacing material

NOTE Requirements for flags are specified in [BS EN 1339:2003](#).

3.1.22 foundation

structure upon which the pavement is constructed

3.1.23 inboard cutting

paving unit within a row, cut in order to allow the cut unit at the edge of the pavement to be greater than one quarter of the length of a standard paving unit

3.1.24 inspection and test plan

plan for managing quality control by providing information on the requirements and an overview of installation methods, the test methods and evidence to be provided to verify compliance and the responsibilities of relevant parties

3.1.25 interlock

effect of frictional forces between paving units in unbound construction which prevents them moving in relation to each other

3.1.26 joint

space between two adjacent units or between paving units and edge restraint

3.1.27 joint offset

distance between joints in adjacent rows of paving units

3.1.28 joint width

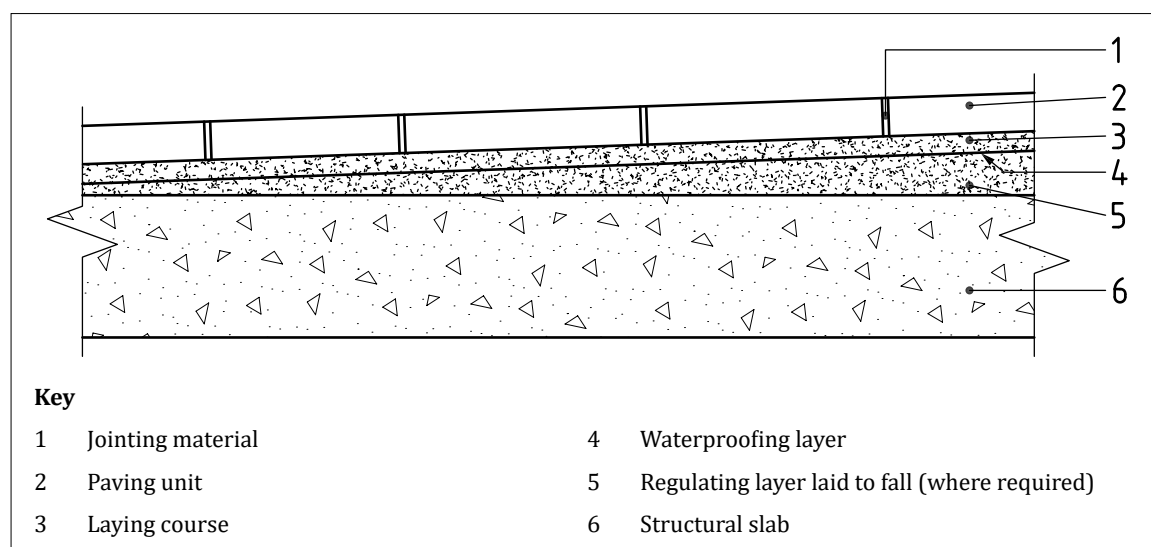
size of the space between adjacent paving units or between paving units and edge restraint

3.1.29 jointing material

material applied to fill the joints between paving units

NOTE See [Figure 1](#) and [Figure 2](#) for illustrations.

Figure 2 — Pavement layers over a structural slab

**3.1.30 laying course**

layer of material on which paving units are bedded

NOTE See [Figure 1](#) and [Figure 2](#) for illustrations.

3.1.31 laying face

working edge of the surface course where paving units are being placed

3.1.32 laying pattern

arrangement of paving units to form specific patterns for either structural requirements or visual effect

3.1.33 level of formation

level above which the structural layers of the pavement are constructed

NOTE See [Figure 1](#) for an illustration. A subgrade improvement or capping layer might be included below the formation layer.

3.1.34 light goods vehicle (LGV)

goods vehicle having a gross weight not exceeding 3 500 kg

NOTE See Driver and Vehicle Licensing Agency guidance leaflet V355/1 [1].

3.1.35 modular pavement

pavement having a surface course comprising paving units with joints between

3.1.36 mortar joint

joint between two units filled with a mixture of fine aggregate and cementitious or other suitable binder

3.1.37 movement joint

joint constructed to allow pavements to expand and contract or flex

3.1.38 nib

small protruding profile on a side face of a block

3.1.39 pavement

paved area subject to pedestrian and/or vehicular traffic

3.1.40 paving unit

prefabricated or selected unit used to form the surface course of a modular pavement

NOTE 1 See [Figure 1](#) and [Figure 2](#) for illustrations. Paving units are also known as “modules” or “pavers”.

NOTE 2 Kerbs and channels can also be referred to as paving units.

NOTE 3 Units with any dimension greater than 2 m are unlikely to be covered by this part of BS 7533.

3.1.41 porcelain paving unit

paving unit manufactured predominantly from naturally occurring clay and minerals, by shaping and firing in a kiln at temperatures greater than 1 200 °C, which produces a fully vitrified, flat paving unit having a very low water absorption of <0.5% (typically 0.1%) with improved strength and durability

3.1.42 race

strip of hardened, levelled concrete onto which kerbs and similar paving units are laid with a layer of bedding mortar

NOTE Also referred to as “windrow” (see [3.1.60](#)) in some regions.

3.1.43 restraint

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

NOTE These can be edge restraint, intermediate or temporary restraint.

3.1.44 screeder board

straight and stiff board of timber, metal or plastic which is drawn across fresh laying coarse material in order to create an accurate level

3.1.45 screeding rail

slender piece of timber, metal or plastic embedded temporarily within a fresh laying course, across which a screeder board is drawn

NOTE Screeding rails are typically 3 m to 5 m in length.

3.1.46 sett

unit of natural stone obtained by cutting or splitting, used as a paving module in which the working width does not exceed two times the thickness

NOTE Requirements for setts are specified in [BS EN 1342](#).

3.1.47 sharp sand

coarse-grained, gritty sand used in concrete and for the laying course in some forms of unbound construction

3.1.48 slab

unit of natural stone obtained by cutting or splitting, used as a paving module for external pavements and road finishes in which the working width exceeds two times the thickness

3.1.49 statutory undertaker

company or agency given general licence to carry out certain works on public highways

NOTE Examples are providers of water, gas, telephone, cable, electricity and sewers.

3.1.50 stiffness modulus (E)

ratio of applied stress to induced strain

NOTE California bearing ratio (CBR) has historically been used as an indirect measure of stiffness. The approximate relationship between the two, acknowledging a degree of uncertainty, is $E = 17.6 (CBR)^{0.64}$ MPa.

3.1.51 stop point

completion of a stage of the works or process for which inspection and approval is to be made before work is allowed to continue

3.1.52 sub-base layer

layer of material placed above the subgrade or capping (if used) which distributes the loading from the upper pavement layers down to the subgrade

NOTE See [Figure 1](#) for an illustration. In some circumstances, the sub-base layer may be omitted.

3.1.53 sub-base material

unbound granular material or bound material used to construct a sub-base layer

NOTE With an unbound base, the sub-base and base might be the same material.

3.1.54 subgrade

part of the soil, natural or constructed, that supports the loads transmitted by the overlying pavement

NOTE See [Figure 1](#) for an illustration.

3.1.55 surface course

layer of paving units, together with bedding or laying course, that comprises the wearing surface of the pavement

3.1.56 traffic categories

classification of traffic for the purposes of pavement construction

NOTE The relevant traffic categories are set out in [Table 1](#).

Table 1 — Traffic categories for pavement construction

Traffic category	Road category ^{A)}	Typical applications
9	1	Adopted highways and commercial/industrial developments used by a high number of commercial vehicles
8	2	
7	3	
6	4	Adopted highways and other roads used by a moderate number of commercial vehicles Pedestrian areas subjected to regular overrun of commercial vehicles Industrial premises Petrol station forecourts
5	N/A	Pedestrian areas subjected to occasional overrun of commercial vehicles Car parks receiving occasional commercial vehicular traffic
4	N/A	Urban footways with unplanned commercial vehicular overrun Pedestrian areas used by light goods vehicles, emergency vehicles and maintenance vehicles ^{B)}
3	N/A	Footways, pedestrian and cycle areas, domestic driveways or access routes subject to manoeuvring of cars and light goods vehicles No access for other commercial vehicles
2	N/A	Footways, pedestrian and cycle areas, parking spaces subject to cars and light goods vehicles No access for other commercial vehicles
1	N/A	Footpaths, pedestrian and cycle areas, excluding all vehicles

^{A)} For road categories, see *Specification for the reinstatement of openings in highways* [N1], Table S1.1. This document is available from local authorities. Differences between this table and the corresponding table in [BS 7533-101:2021](#) reflect differences in national regulation since 2021.

^{B)} When being driven, a mobile elevated working platform (MEWP) is treated as a vehicle, but the deployment of its stabilizers requires Category 4 as a minimum.

3.1.57 unbound construction

paving units laid on and jointed with unbound aggregate

NOTE This has often previously been referred to as “flexible construction”.

3.1.58 unbound surface course

surface course where paving units are bedded on and jointed with granular material, with no binder added

3.1.59 void

unfilled space in the pavement construction

3.1.60 windrow

strip of fresh concrete onto which kerbs and similar units are laid directly

NOTE See also [3.1.42](#).

3.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

CBGM	cement bound granular material
CBR	California bearing ratio
DoP	Declaration of Performance
DPM	damp-proof membrane
MEWP	mobile elevated working platform
N/A	not applicable
PPV	polished paver value
PSD	particle size distribution
PSRV	polished slip resistance value
USRV	unpolished slip resistance value

4 Traffic categories 3 and below where no design has been provided in accordance with [BS 7533-101:2021](#)

4.1 General

COMMENTARY ON 4.1

An unbound surface course generally requires more maintenance than a bound surface but might be more easily repaired and can be lifted and re-laid, thus extending the life of the pavement indefinitely.

Bound surface course construction laid over a bound base layer provides the stiffest combination and generally allows the use of thinner paving units in the same loading and traffic conditions. However, there is a risk that cracks form if the surface is overloaded or poorly constructed.

Thin paving slabs of natural stone or porcelain and concrete flags are at the lowest risk of failure when bonded onto a concrete base using high-performance proprietary bedding and bonding mortar.

Laying flags and slabs onto a bedding mortar, over an unbound base, avoids the uncertainty of adequately compacting an unbound laying course. The mass of bedding mortar adhering to the underside of the flag or slab adds to the overall mass of the paving unit, enhancing stability and reducing the risk of trip hazards forming.

The practice of laying down a strong geosynthetic or lightweight stainless-steel mesh as laying of the bedding mortar proceeds over an unbound base provides additional tensile strength and reduces the risk of cracks forming in the surface course.

For sites where a design has been provided in accordance with [BS 7533-101:2021](#), the recommendations of [4.2](#) to [4.9](#) are not applicable.

For sites in traffic categories 3 and below, where no design has been provided in accordance with [BS 7533-101:2021](#), the recommendations of [4.2](#) to [4.9](#) should be followed.

NOTE When being driven, a MEWP is treated as a vehicle, but the deployment of its stabilizers requires traffic category 4 as a minimum.

4.2 Surface drainage

COMMENTARY ON 4.2

Surface water can penetrate the pavement structure through joints in unbound pavements and cracks in bound pavements. Water which cannot freely drain can result in damage to the materials and the structure.

Persistent dampness of the pavement surface can lead to discoloration and growth of flora such as algae and moss, sometimes referred to as “greening”, which might cause the pavement to become slippery and dangerous for both pedestrians and vehicles.

Sufficient fall should be provided in accordance with [Annex B](#) to allow surface water to flow freely to a drainage fitting without ponding.

At least one drainage fitting should be provided per 75 square metres or part thereof of paving, and surface water should not be required to travel a distance greater than 10 linear metres to reach a drainage fitting.

4.3 Paving units and their installation

4.3.1 Performance criteria for paving units

COMMENTARY ON 4.3.1

The performance criteria for precast concrete and clay paving units are recommended using performance classes, as described in the relevant product standards.

The performance criteria for natural stone paving units are recommended using declared values, with units as described in the relevant product standards. Where a performance criterion has not been tested, the three initials NPD are written, to mean “no performance declared”.

Further information on products and how performance is tested and described is given in [Annex C](#).

The unpolished slip resistance (USRV) of paving units should be not less than 40.

NOTE 1 Information on slip/skid resistance is given in [Annex D](#).

NOTE 2 Unless they have been ground or polished, precast concrete paving units and clay pavers are assumed to achieve the recommended value.

NOTE 3 Coarse textured and hewn natural stone paving units are assumed to give satisfactory slip resistance.

In areas with intensive pedestrian traffic, in which some types of natural stone (most commonly, limestone) can become polished with time, paving units with a polished paver value (PPV) of 45 or greater should be selected to avoid this.

NOTE 4 Intensive pedestrian traffic refers to areas expected to receive more than 500 million pedestrians in the life of the pavement. Examples are busy commuter stations, airports and large shopping malls.

If a different characteristic bending strength or class to that recommended in [Table 2a](#) is declared by the supplier for concrete flags, a unit thickness design should be provided in accordance with [BS 7533-101:2021](#).

Slabs comprising a thin natural stone or porcelain surface bonded to a precast concrete flag should be considered as having similar mechanical properties and be treated in the same way as concrete flags in accordance with [Table 2a](#)).

NOTE 5 The recommendations for natural stone slabs in [Table 2b](#)) are divided into three strength classes [see Note ^{e)}].

When it is known that the flexural strength is less than 8 MPa, a unit thickness design should be provided in accordance with [BS 7533-101:2021](#).

NOTE 6 Where a declared value for the flexural strength of natural stone is available, the user or supplier may determine length, aspect ratio and thickness based on the formulae in [BS 7533-101:2021](#).

NOTE 7 When no values for flexural strength of natural stone are declared, slabs are required to be 50% thicker than would be required for slabs of flexural strength 8 MPa.

The recommendations of [Annex C](#), [C.11.3](#) for abrasion resistance, [C.11.4](#) for water absorption and [C.11.5](#) for weathering resistance should be followed.

NOTE 8 An increased risk of failure exists where no values for flexural strength have been declared. A similar risk exists where the other recommendations for the properties of the stone given in [Annex C](#) are not followed.

4.3.2 Standard dimensions of paving units

The length of concrete blocks and natural stone setts should not exceed four times the thickness, and the thickness of natural stone setts should additionally be not less than half the width.

The length of clay pavers selected should not exceed six times the thickness. The thickness for these units should be in accordance with [Table 2c](#)).

NOTE The thickness required for natural stone setts is affected by the laying pattern. Minimum thickness given in [Table 2c](#) is sufficient for setts laid transversely across the traffic flow or at 45° to it, or in segmental arches. Other laying patterns are covered by [BS 7533-101:2021](#), [6.7.3](#).

Natural stone setts to be laid unbound should always have cropped sides and be laid such that each sett touches all the adjoining setts.

Stone setts with sawn sides selected for laying unbound should have the same dimensional tolerances specified in [BS EN 1338:2003](#), Table 1 and Table 2, for concrete blocks. The pavement should be constructed in the same way as for concrete block paving laid in the same format.

The length of precast concrete flags should not exceed 1 000 mm.

The length of natural stone slabs, porcelain paving units and composite concrete-porcelain paving units should not exceed 1 200 mm.

The maximum aspect ratio and minimum thickness for concrete paving units should be as recommended in [Table 2a](#)).

If a different plan dimension to that recommended in [Table 2a](#)) is required for concrete flags or [Table 2b](#)) for natural stone slabs, the unit thickness should be calculated in accordance with [BS 7533-101:2021](#), [6.6.3](#).

The maximum aspect ratio and minimum thickness for natural stone units should be as recommended in [Table 2b](#)) and for porcelain paving as recommended in [Table 2d](#)).

The maximum aspect ratio and minimum thickness for concrete block pavers, natural stone setts and clay pavers should be as recommended in [Table 2c](#)).

Table 2a) — *Concrete flags*^{A)}

Standard designation	Dimensions			Maximum recommended traffic category for surface construction		
	Length	Width	Depth	Unbound over a bound or unbound base	Bound over a bound or unbound base	Bound bonded to a concrete base
A50	600	450	50	1	2	3
A63	600	450	63	2	3	3
B50	600	600	50	2	3	3
B63	600	600	63	3	3	3
C50	750	600	50	1	2	3
C63	750	600	63	2	2	3
D50	900	600	50	1	1	3
D63	900	600	63	2	2	3
E50	450	450	50	2	3	3
E70	450	450	70	3 ^{B)}	3	3
F50	400	400	50	2	3	3
F65	400	400	65	3 ^{B)}	3	3
G50	300	300	50	2	3	3
G60	300	300	60	3 ^{B)}	3	3

^{A)} Concrete flags outside these standard designations, or with less than Class 3 strength, are limited to traffic category 1 applications.

^{B)} E70, F65 and G60 flag pavements, designed in accordance with [BS 7533-101:2021](#) and laid flexibly can be used for traffic applications higher than category 3.

Table 2b) — Limiting dimensions and thickness: Natural stone paving slabs

Traffic category	Construction type	Paving unit type ^{B)}	Minimum thickness (mm) at length and aspect ratio			
			≤600 mm		>600 mm	
			1.5:1	2:1	1.5:1	2:1
3	Unbound ^{A),B)}	8 MPa	75	75	75	75
		12 MPa	75	75	75	75
		21 MPa	75	75	75	75
	Bound A ^{C),F)}	8 MPa	45	55	55	65
		12 MPa	40	45	45	55
		21 MPa	30	35	35	40
	Bound B ^{D),F)}	8 MPa	30	35	30	35
		12 MPa	25	30	25	30
		21 MPa	20	25	20	25
2	Unbound ^{A)}	8 MPa	45	50	50	60
		12 MPa	35	40	40	50
		21 MPa	30	30	30	35
	Bound A ^{C),F)}	8 MPa	35	40	45	50
		12 MPa	30	35	35	40
		21 MPa	25	25	30	30
	Bound B ^{D),F)}	8 MPa	25	30	25	30
		12 MPa	20	25	20	25
		21 MPa	20	20	20	20
1	Unbound ^{A)}	8 MPa	20	25	25	30
		12 MPa	20	20	20	25
		21 MPa	20	20	20	20
	Bound A ^{C),F)}	8 MPa	20	20	20	25
		12 MPa	20	20	20	20
		21 MPa	20	20	20	20
	Bound B ^{D),F)}	8 MPa	20	20	20	20
		12 MPa	20	20	20	20
		21 MPa	20	20	20	20

A) Unbound surface over unbound or bound base.

B) The values are conservative due to the risk of these units moving, which can result in failure of the pavement.

C) Bound surface over unbound or bound base.

D) Bonded to a concrete base.

E) 8 MPa stone has minimum flexural strength 8 MPa; 12 MPa stone has minimum flexural strength 12 MPa; 21 MPa stone has minimum flexural strength 21 MPa. When no values for flexural strength have been declared, slabs 50% thicker than 8 MPa may be assumed.

F) Assumes minimum width = 200 mm and minimum area = 50 000 mm².

Table 2c) — *Concrete blocks, clay pavers and natural stone setts*

Product type	Specification	Minimum thickness (mm)		
		Unbound ^{A)}	Bound A ^{B)}	Bound B ^{C)}
Traffic category 3				
Concrete blocks	Classes 1, 2 and 3	50	50	50
Clay pavers	Class T4	60	50	30
Natural stone setts ^{D)}	All	80	70	50
Traffic category 2				
Concrete blocks	Classes 1, 2 and 3	50	50	50
Clay pavers	Classes T3 and T4	50	40	30
Natural stone setts ^{D)}	All	65	55	50
Traffic category 1				
Concrete blocks	Classes 1, 2 and 3	50	50	50
Clay pavers	Classes T1, T2, T3 and T4	40	30	30
Natural stone setts ^{D)}	All	65	55	50

A) Unbound surface over unbound or bound base.

B) Bound surface over unbound or bound base.

C) Bonded to a concrete base.

D) Minimum thickness is sufficient for setts laid transversely across the traffic flow or at 45° to it, or in segmental arches. Other laying patterns are covered by [BS 7533-101:2021](#), 6.7.3.

Table 2d) — *Limiting dimensions and thickness: Porcelain paving units of 35 MPa^{A)}*

Traffic category	Construction type	Minimum thickness (mm) at length and aspect ratio			
		≤600 mm		>600 mm	
		1.5:1	2:1	1.5:1	2:1
3	Unbound ^{B)}	N/A	N/A	N/A	N/A
	Bound A ^{C)}	25	25	30	30
	Bound B ^{D)}	20	20	20	20
2	Unbound ^{B)}	N/A	N/A	N/A	N/A
	Bound A ^{C)}	20	20	20	25
	Bound B ^{D)}	20	20	20	20
1	Unbound ^{B)}	N/A	N/A	N/A	N/A
	Bound A ^{C)}	20	20	20	20
	Bound B ^{D)}	20	20	20	20

A) 35 MPa porcelain has minimum flexural strength 35 MPa.

B) Unbound surface over unbound or bound base.

C) Bound surface over unbound or bound base.

D) Bonded to a concrete base.

4.3.3 Non-standard paving units

Where paving units which do not achieve the performance or dimensions recommended in 4.3.1 and 4.3.2 are to be used in traffic categories 3 and below, a unit thickness design should be provided in accordance with BS 7533-101:2021.

4.3.4 Joint width

4.3.4.1 Joint width for unbound construction

The nominal joint width for unbound construction should be as recommended in Table 3.

Table 3 — *Joint widths for unbound surface construction*

Paving unit	Joint width mm
Concrete block paving units	2 to 5
Clay paving units	3 to 6
Sawn stone slabs and concrete flags	2 to 5
Stone slabs with fettled edges	6 to 12
Cropped stone setts 100 mm or less in width	0 to 10
Cropped stone setts more than 100 mm in width	0 to 15

The apparent joint width between natural stone setts having cropped sides is governed by the roughness of the sides; when laid, each sett should be in contact with adjacent setts at one or more points.

For sawn sandstone setts, precast concrete blocks and clay pavers, natural stone slabs and concrete flags having chamfers, the joint width should be as recommended in Table 3.

NOTE Joint width might be governed by the presence of nibs cast onto the sides of the paving units and joint spacers may be used to generate a greater joint width and to provide stability.

4.3.4.2 Joint width for bound construction

A joint filled with mortar should be not less than 5 mm in width for a slurry grout or 10 mm for a plastic mix and not greater than 25 mm at any point.

4.3.5 Construction depth

4.3.5.1 General

The construction depth should comprise the thickness of the paving unit given in Table 2a), 2b), 2c) or 2d), as applicable, plus the depth of the laying course or bedding layer, base layer and sub-base layer, if required, given in Table 4.

4.3.5.2 Thickness of bedding or laying course

The bedding or laying course thickness should be as given in Table 4.

Table 4 — *Laying course, base and sub-base thickness*

Construction type	Traffic category	Paving unit type	Laying course or bedding layer thickness and material	Base thickness and material	Sub-base thickness		
					Subgrade CBR >2.5% to ≤5%	Subgrade CBR >5%	
Unbound surface over unbound or bound base	3	Clay pavers	30 mm sharp sand or 40 mm crushed rock	≥150 mm unbound material ≥100 mm CBGM or concrete	≥200 mm unbound material	≥100 mm unbound material	
		Concrete block pavers					
		Sawn-sided setts					
		Concrete flags					
		Stone slabs	40 mm crushed rock				
		Cropped-sided setts					
	2	Clay pavers	30 mm sharp sand or 40 mm crushed rock	≥100 mm unbound material or ≥ 100 mm CBGM or concrete	≥100 mm unbound material	No sub-base required	
		Concrete block pavers					
		Sawn-sided setts					
		Concrete flags					
		Stone slabs	40 mm crushed rock				
		Cropped-sided setts					
	1	Clay pavers	30 mm sharp sand or 40 mm crushed rock	No sub-base required			
		Concrete block pavers					
		Sawn-sided setts					
		Concrete flags					
		Stone slabs	40 mm crushed rock				
		Cropped-sided setts					
Bound surface over unbound base	3	Clay and concrete pavers, all natural stone setts	40 mm bedding mortar	≥150 mm unbound material	≥200 mm unbound material	≥100 mm unbound material	
		Concrete flags, natural stone and porcelain paving units	40 mm bedding mortar with bonding mortar				
	2	Clay and concrete pavers, all natural stone setts	40 mm bedding mortar	≥100 mm unbound material	≥100 mm unbound material	No sub-base required	
		Concrete flags, natural stone and porcelain paving units	40 mm bedding mortar with bonding mortar				
	1	Clay and concrete pavers, all natural stone setts	40 mm bedding mortar				
		Concrete flags, natural stone and porcelain paving units	40 mm bedding mortar with bonding mortar				
	Bonded to concrete	3	All paving unit types	40 mm bedding mortar with bonding mortar applied to both underside of paving unit and surface of concrete base	≥100 mm concrete	≥200 mm unbound material	≥100 mm unbound material
		2				≥100 mm unbound material	No sub-base required
1		No sub-base required					

A) See 5.8.2 for the determination of CBR.

4.3.6 Base layer for all surface construction types

4.3.6.1 Minimum thickness

The base course layer for all surface construction types should be constructed with the following minimum thickness or greater if required by [Table 4](#):

- a) unbound base: 100 mm; or
- b) CBGM base: 100 mm; or
- c) concrete base: 100 mm.

Where a bound base layer is impermeable, secondary drainage to the bedding layer should be provided in order to prevent the layer becoming saturated with water in service.

4.3.6.2 Sub-base and base layer materials

Only materials and mixtures recommended in [Annex C, C.1](#), should be used in the unbound base and sub-base layers for pavements.

Layers should be compacted using proprietary equipment such as a vibrating roller, vibratory plate compactor or vibro-tamper. The information provided by the manufacturer should first be checked for a clear statement about the suitability of equipment for the application and adequate guidance for its correct use.

NOTE 1 [Annex E, Table E.1](#), provides the maximum thickness of an unbound sub-base or base layer, using generally available equipment for a minimum of four passes (two longitudinal and two transverse). The vibratory compaction equipment described in [Annex E, Table E.2](#), is typical of equipment provided and can assist in understanding manufacturers' designation of equipment sizes.

CBGM should be compacted within 2 h of manufacture and not be allowed to dry before being installed.

Concrete base should conform to [BS EN 13877-1](#) with a minimum compressive strength class C20/25.

Where a bound base layer is impermeable, secondary drainage to the bedding layer should be provided in order to prevent the layer becoming saturated with water in service.

Where 50 mm diameter holes are being provided on a 2 m orthogonal grid and at low points to provide secondary drainage through bound base layers, the holes should be:

- a) filled with coarse graded aggregate (CGA) or water-permeable laying course aggregate (see [Annex C, C.4](#)); and
- b) covered with a specifically designed non-woven filter fabric, which extends at least 150 mm either side of the drainage hole, to prevent loss of the laying course.

NOTE 2 Weepholes within edge restraints and linear drainage systems may be used to allow water to escape from the laying course.

4.4 Site assessment and investigation

4.4.1 Presence of plants and tree roots

Where roots or creeping invasive plants are present, an assessment should be made as to how these could affect the structural integrity of the paving over time and appropriate measures implemented to mitigate any effects.

NOTE 1 For example, if a tree preservation order is in place affecting nearby ground, a "no dig" or "shallow dig" solution might be required.

NOTE 2 If the construction site is in a conservation area, the approval of the local planning authority is required for the intended work/activity. The protection of a conservation area extends to trees in public and private land.

4.4.2 Visual site investigation

Visual site investigation should involve:

- a) identification of the existing surface type; and
- b) collecting evidence of surface water drainage.

4.4.3 Simple intrusive investigation

A simple intrusive investigation should be carried out where necessary to establish the nature of the existing soil and subgrade.

To assess the condition of the ground on which the pavement is to be constructed, trial holes should be excavated, and the subgrade assessed in accordance with [5.8.2](#).

If no suitable subgrade material is present within 500 mm of the surface, an engineering design should be carried out in accordance with [BS 7533-101:2021](#).

4.4.4 Previously built ground

4.4.4.1 General

When constructing a modular pavement over previously built ground, for example when replacing or overlaying an existing driveway, arrangements should be made for recycling existing materials that are to be removed, as appropriate.

Where it is intended to overlay existing layers of material as a substitute for a new sub-base or base layer, the thickness and stiffness, as appropriate, of those material layers should be not less than the minimum values given in [Table 4](#).

Prior to being accepted, materials to be overlaid should be inspected and assessed in accordance with [5.8.4](#).

Where an existing base is impermeable, secondary drainage to the bedding layer should be provided in order to prevent the layer becoming saturated with water in service.

NOTE 1 This may be effected by coring the base with 50 mm diameter holes on a 2 m orthogonal grid and filling with CGA or water-permeable laying course aggregate (see [Annex C](#), [Table C.4](#)).

Where an existing base is not laid to a fall, an assessment should be made as to whether to create a gradient using a regulating layer or screed. Where possible, the fall of the base should replicate the fall of the pavement surface.

Where the surface of the base falls to low points, provision should be made for water to drain freely to a sub-surface drainage fitting or suitable egress.

NOTE 2 Water which accumulates within the laying course of a pavement can generate water vapour in hot weather, which might result in staining of the pavement surface.

4.4.4.2 Adjacent areas combining existing base and new base construction

Where a new base course is to be laid adjacent to an existing base, unequal movement should be expected and a determination made of the need to compensate for unequal lateral and vertical movement of the adjacent paved surfaces.

Where a new base course is laid adjacent to an existing base and the surface course is laid in unbound construction, unequal settlement during the life of the pavement should be compensated for by setting the level of the surface course over the new base between 1 mm and 3 mm higher.

4.5 Kerbs and restraints

4.5.1 Kerbs and perimeter edge restraints

COMMENTARY ON 4.5.1

Kerbs, edgings or edge restraints are necessary for all free edges of unbound pavements. Free edges are those not bounded by a stable fixed structure such as a wall or adjacent area of bound paving.

Kerbs and edgings may also be used with bound pavements.

Kerbs and edgings should be not less than 300 mm in length unless manufactured as intentionally shorter units, such as small unit kerbs.

Kerbs, edgings and edge restraints should be laid on a fresh or hardened race with mortar, and haunched with concrete as soon as possible after installation.

The depth of the concrete race should be not less than 100 mm.

Haunching should extend up to at least half the depth of the kerb units but not higher than within 60 mm of the adjacent pavement surface or the depth of the surface course below the top of the kerb unit. The width of haunching should be not less than 100 mm.

Laying tolerances, line and level, should be in accordance with [Clause 12](#).

Kerbs and edgings laid to a radius less than 10 m should be ordered as preformed, radiused units or formed using straight units not greater than 300 mm in length.

Where possible, the ends of kerbs and edging units should be cut in order to maintain close joints (2 mm to 5 mm). At no point should kerbs and edging units be butt jointed.

Where wider joints are unavoidable, mortar should be used to fill joints.

Any joint to be filled with mortar should be not less than 6 mm and not greater than 15 mm in thickness.

NOTE Edge restraints may comprise one or more rows of bound paving units or a fixed kerb or channel that is laid with the surface flush with the surrounding paving.

4.5.2 Intermediate restraints

COMMENTARY ON 4.5.2

Intermediate restraints are positioned within an area of unbound paving to restrain lateral movement and limit creep of the surface course. They may comprise flush kerbs and channels or feature matching or complementary paving units.

Where more than one intermediate restraint is required, they are generally spaced evenly across the pavement. The maximum distance between intermediate restraints is dependent upon slope and laying pattern.

Intermediate restraints should be provided within areas of unbound paving where a steep slope or trafficking could otherwise result in lateral creep of the paving units.

Intermediate restraints should be laid on a fresh or hardened race with mortar, and haunched with concrete as soon as possible after installation.

The distance between an intermediate restraint and another intermediate or edge restraint is typically 6 m to 10 m and the maximum distance should not exceed 15 m.

Where paving is laid to a slope of 1 in 20 or steeper, intermediate restraints should be positioned more closely together.

NOTE Intermediate restraints may comprise one or more rows of bound paving units or a fixed kerb or channel that is laid with the surface flush with the surrounding paving.

4.6 Installation of kerbs and restraints

Where kerbs and restraints are to be installed, the recommendations of [Clause 9](#) should be followed.

4.7 Construction of sub-base and base

For the construction of sub-base and base, the recommendations of [Clause 7](#) should be followed.

4.8 Construction of an unbound surface course

Where an unbound surface course is to be constructed, the recommendations of [Clause 14](#) should be followed.

4.9 Construction of a bound surface course

Where a bound surface course is to be constructed, the recommendations of [Clause 15](#) should be followed.

5 Pre-construction phase for work in all traffic categories

5.1 Review of design and specification

The design and specification should be reviewed for suitability of intended use and compliance with [BS 7533-101:2021](#) or [Clause 4](#).

Where a design deviates from the recommendations of [BS 7533-101:2021](#) or [Clause 4](#), it should be verified that any alternative is demonstrated to achieve an equivalent or better outcome and the details are recorded.

5.2 Construction drawings

It should be confirmed that construction drawings agree with the written design and specification. Any discrepancies should be brought to the attention of the project manager.

5.3 Risk assessments

A risk assessment of the site should be carried out to:

- a) identify what could cause injury or illness (hazards);
- b) determine how likely it is that someone could be harmed and how seriously (the risk); and
- c) identify action to eliminate the hazard, or if this is not possible, control the risk.

Risk assessments should be constantly reviewed and updated as required and made available to the project manager.

5.4 Storage and disposal of waste

All contaminated materials should be stored separately and liquid waste and rainwater draining from stored waste should be prevented from running into adjacent ground and water courses.

NOTE Waste can only be removed from site by a carrier registered for the licensed disposal of waste.

5.5 Construction programme management

A construction programme, e.g. a Gantt chart, should set out the sequences, milestones, hold points and key dates of the construction process in a logical format.

The construction programme should be regularly reviewed, updated to show progress against the timeline and reported to the project manager.

Lead times for the provision of critical services, such as statutory undertakers, traffic management and site access, should be taken into account.

5.6 Method statement

5.6.1 General

Prior to the start of works, the contractor should produce a method statement which lists the tasks to be carried out and the checks they intend to carry out in order to confirm that the works have been carried in accordance with the design.

The method statement should be kept up to date.

The method statement should be made available to the project manager and address some or all of the topics in 5.6.2 to 5.6.7.

5.6.2 Hold points

A list of hold points should be prepared comprising a process, or series of processes, which clearly defines the completion of a stage in the works and beyond which work cannot proceed without approval.

When work completed at a hold point is found to be contaminated or otherwise substandard, all faults should be rectified before work proceeds to the next stage.

5.6.3 Personnel and welfare

The method statement should clearly identify the project manager.

Where multiple teams are working on a project, each team should include a person who is responsible for the immediate organization of that team and who reports to their immediate superior or directly to the project manager.

NOTE 1 Users of this part of BS 7533 are advised to consider the desirability of treating a skills card issued by the Construction Skills Certification Scheme (CSCS) or other suitable scheme, such as NHSS 30 (National Highways Sector Scheme 30)³⁾, as recognized qualifications for relevant skills.

Welfare facilities should be provided.

NOTE 2 Roles and responsibilities of the various parties involved are set out in Annex F.

5.6.4 Equipment

The equipment selected for use should be appropriate, well maintained and appropriately certified.

The selection and location of equipment for the mixing of mortar should be carefully reviewed. The relative risks and inconvenience of siting a mixer remotely and transporting fresh mortar to the position of installation should be balanced against a mixer and raw materials being located at the position of installation.

NOTE 1 Specialist hand tools and mechanized equipment are described in the technical training manuals for unbound and bound modular paving prepared for National Highways Sector Scheme 30 ([2], [3], [4]).

NOTE 2 Guidance on compaction equipment is given in Annex E.

³⁾ CSCS and NHSS 30 are examples of suitable schemes. This information is given for the convenience of users of this document and does not constitute an endorsement by BSI of these products.

5.6.5 Materials

Where applicable, materials should conform to the requirements of the project specification. If the specification is either incomplete or unclear, the matter should be brought to the attention of the client.

If required, reference samples of paving units and visible components should be provided, such as cured jointing mortar, comprising an adequate number of a sufficient size to indicate the general appearance of the finished work. The recommendations of [Annex G](#) should be followed for visual inspection and acceptance of reference samples.

NOTE The client or designer may request a sample panel for the purpose of comparing and evaluating the appearance of the completed pavement as designed and specified.

5.6.6 Reclaimed paving

Where the client or designer requests reclaimed materials for the surface course, and production of that material has ceased and the technical characteristics are not known, the contractor should seek examples of comparable materials used in similar ways and weather conditions. Where required, the slip resistance should be tested, and sufficient examples of the stone assessed for its abrasion value and its flexural strength. The frost resistance should be assessed visually if the stone has been used externally before.

NOTE Experience or successful local use may be relied upon.

If reclaimed material has not been obtained in advance and is required by the client, the material should be acquired as soon as possible and approval from the client obtained.

5.6.7 Lead times

Allowance should be made for lead times when ordering materials, especially for natural stone, manufactured materials which are not standard, and stock products that are being manufactured exclusively for the project.

5.6.8 Acceptance and storage of materials

The supervisor should verify that materials are stored safely and maintained in suitable conditions to prevent damage and deterioration.

5.6.9 Recording and correcting defects identified during the installation

Records should identify and describe any defects identified during installation and confirm that the remedial works carried out are acceptable.

5.7 Inspection and test plan

Where the design and execution of a project includes an inspection and test plan, this should include checking:

- a) the set-out for preparatory groundworks;
- b) for utilities prior to excavation;
- c) the suitability of subgrade/formation level;
- d) for any geosynthetic layers;
- e) the subgrade drainage;
- f) the capping/improvement layers;
- g) the sub-base and base, in particular for contamination;
- h) the alignment of movement joints in the base with surface course laying pattern;

- i) the kerbs and edge, or intermediate restraints;
- j) the sub-surface drainage;
- k) the surface course levels and falls;
- l) the laying pattern and joint widths; and
- m) the cleanliness of the completed surface course.

The design specification should be checked to ascertain the requirements to be met and the standards to be followed.

The person or laboratory sampling and testing materials should be identified, and the frequency of testing should be recorded.

5.8 Site investigation

5.8.1 General

The contractor should carry out a sufficient site investigation to validate the design information provided.

5.8.2 Trial holes and ground conditions

In order to assess the condition of the exposed subgrade, trial holes should initially be excavated to the proposed construction depth:

- a) a minimum of two trial holes should be excavated for a site of 100 m² or less; or
- b) a minimum of one trial hole per 50 m² should be excavated for a site greater than 100 m².

The location of trial holes should include low points within the area to be paved.

If standing water, topsoil, loose backfill or any unexpected material is detected at the base of a trial hole, the depth of the trial hole should be increased until a suitable subgrade is identified, up to a maximum of 500 mm.

To assess CBR when following the recommendations of [Clause 4](#) in traffic category 3, tread firmly upon dry ground, wearing a conventional construction industry safety shoe or boot, and determine the depth of the imprint. When this test is applied:

- 1) if an imprint of 2 mm or less is formed, a CBR of approximately 5% may be assumed and a sub-base layer should be added only if required by the construction;
- 2) if an imprint of 2 mm to 4 mm is formed, a CBR of approximately 2.5% may be assumed, and the required depth of sub-base should be added; and
- 3) if an imprint greater than 4 mm is formed, the design process given in [BS 7533-101:2021](#) should be followed.

NOTE 1 Further information on assessment of the subgrade is given in [Annex H, Table H.1](#). In all situations, the subgrade CBR can be estimated from the soil properties as given in [Annex H](#).

NOTE 2 For large areas of paving, it might be economical to employ a laboratory technician to carry out a CBR test using a light weight deflectometer in accordance with [BS 1924-2](#).

If the CBR is found to be greater than the design requirement, the thickness of the layers above should not be reduced.

Only where the site investigation confirms and validates the design provided should work proceed.

If the site investigation fails to confirm the design requirements for CBR, the contractor should inform the client and seek further instructions.