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BRITISH STANDARD

BS 7533-2:2001
Incorporating
Corrigendum No. 1

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

ICS 93.080.20

Confirmed
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Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee B/507, Paving units and kerbs, upon which the following bodies were represented:

Brick Development Association
British Cement Association
British Ceramic Research Ltd.
British Precast Concrete Federation Ltd.
Concrete Society
County Surveyors' Society
Department of the Environment, Transport and the Regions (Highways Agency)
Institution of Civil Engineers
Interlay (Association of Block Paving)
Interpave (Concrete Block Paving Association)
Landscape Institute
Society of Chemical Industry
Stone Federation
Transport Research Laboratory

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Amd. No.	Date	Comments
13217	June 2001	Correction of error in title

Contents

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Foreword

This part of BS 7533 has been prepared by Technical Committee B/507. It supersedes BS 6677-2:1986, which is withdrawn.

BS 7533 will be published in 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*[1)]*: Guide for the design of pavements (other structural aspects);*

— *Part 6: Code of practice for laying natural stone, precast concrete and clay kerb units;*

— *Part 7*[1)]*: Code of practice for the construction of pavements of natural stone setts;*

— *Part 8*[1)]*: Guide for the structural design of lightly trafficked pavements of precast concrete flags and natural stone slabs;*

— *Part 9*[1)]*: Code of practice for laying clay pavers.*

Annex A is informative.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 8, an inside back cover and a back cover.

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[1)] In preparation.

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1 Scope

This British Standard provides guidance on the design of lightly trafficked pavements surfaced with clay or concrete block pavers manufactured in accordance with BS 6677-1 or BS 6717-1 respectively and laid in accordance with BS 7533-3. It applies to all paved areas subjected to the usual road spectrum of axle loads up to 11 000 kg and trafficked by up to 0.5 million cumulative standard axles (msa), e.g. culs-de-sac, driveways, car parks, precincts, lightly trafficked roads and paved areas.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of this British Standard. For dated references, subsequent amendments to, or revisions of any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

BS 4987-1, *Coated macadam (asphalt concrete) for roads and other paved areas — Part 1: Specification for constituent materials and for mixtures.*

BS 6677-1, *Clay and calcium silicate pavers for flexible pavements — Part 1: Specification for pavers.*

BS 6717-1, *Precast concrete paving blocks — Part 1: Specification for paving blocks.*

BS 7533-1, *Pavements constructed with clay, natural stone or concrete pavers — Part 1: Guide for structural design of pavements constructed of clay or concrete block pavers.*

BS 7533-3, *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.*

3 Terms and definitions

For the purposes of this part of BS 7533 the following terms and definitions apply.

3.1
paver

either a clay paver or a concrete block paver

3.2
laying course

layer of material on which pavers are bedded

3.3
subgrade

upper part of the soil, natural or constructed, that supports the loads transmitted by the overlaying road structure (see Figure 1)

3.4
pavement

any paved area subject to pedestrian and/or vehicular traffic

3.5
sub-base

one or more layers of material placed immediately above the subgrade (see Figure 1)

3.6
roadbase

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

NOTE The roadbase can be a bituminous material and/or cement bound material.

3.7
cement bound material (CBM)

granular material to which cement has been added

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3.8
channelized traffic

traffic where the vehicle track width and the traffic lane width are virtually the same, e.g. narrow entrances such as gates

NOTE Normal lane widths in a highway do not constitute channelized traffic.

3.9
standard axle

axle carrying a load of 8 200 kg

3.10
cumulative traffic

number of standard axles a pavement is designed to carry, measured in million standard axles (msa)

3.11
commercial vehicle

vehicle having an unladen weight exceeding 1 5 t

3.12
lightly trafficked pavement

pavement which receives a limited number of heavy vehicles

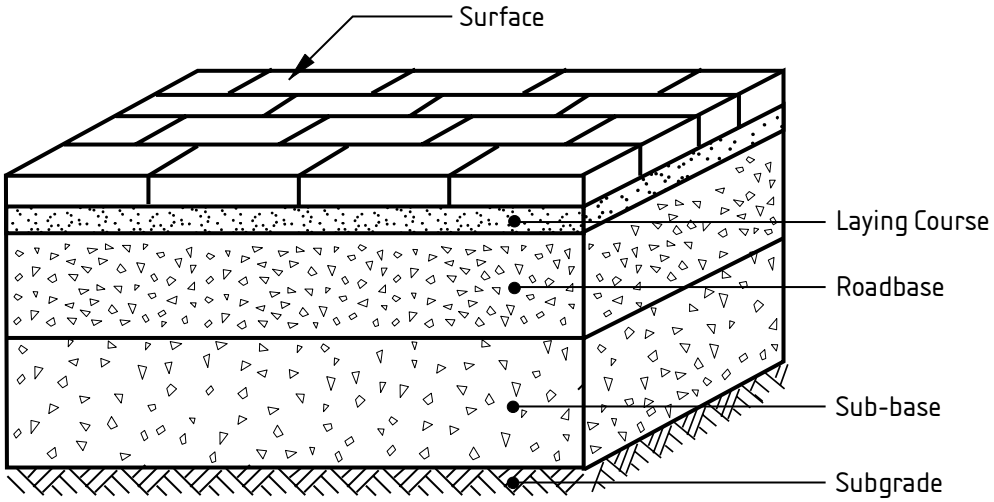

Figure 1 — Typical cross-section of pavement

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4 General design criteria

4.1 Subgrade assessment

The design is based upon an assessment of the subgrade bearing strength described as the CBR (California Bearing Ratio). The weaker the subgrade, the stronger the pavement is required to be.

The design CBR should be obtained by measurement of the plasticity index or material description of the subgrade and by use of Table 1.

For category IV only (see Table 2), a guide to subgrade strength may be estimated by using a simple field test given in Annex A (see also Table 1). This is intended to be an indicator of the strength of this layer. Tests are carried out after the initial compaction of the trimmed ground.

4.2 Evaluation of traffic

The number of commercial vehicles using the area should first be obtained. Table 2 gives the categories of classification for the different applications.

For category I and II vehicles, usage and the relationship of standard axles should be estimated in accordance with Table 3. As the type of commercial vehicles using the pavement will be mixed the probable daily amount of each type of vehicle should be determined in order to estimate the total number of standard axles per day.

Design should take into account the cumulative traffic which the pavement has to carry, measured either in terms of the number of commercial vehicles per day (cv/d) or the number of standard axles.

A 20 year design life should be generally applicable unless access for possible maintenance of the roadbase is likely to be difficult or expensive in which case a longer design life may be advisable. Where the pavement serves a finite area, zero growth in traffic is likely to be applicable. If calculated growth figures are available these should be used to ascertain the number of standard axles.

It may be necessary to reset the pavers during the life of a pavement. This may be a result of displacement of the laying course sand and is not necessarily an indication of pavement failure.

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Table 1 — CBR values for different materials

Type of soil	Plasticity index	Estimated CBR
Heavy clay	70	2
	60	2
	50	2
	40	3
Silty clay	30	4
Sandy clay	20	5
	10	5
Silt	—	1
Sand poorly graded	—	20 (7[a])
Sand well graded	—	40 (10[a])
Sandy gravel	—	60 (15[a])

NOTE 1 Table 1 is intended for use where the water table is 300 mm or more below formation level. In other conditions, specialist advice should be sought.

NOTE 2 Effective subgrade drainage can have a significant effect on long-term CBR values and should be considered during the design procedure. Filter drains set at the appropriate level and discharging to a satisfactory outfall or main drainage system have been found to perform satisfactorily.

NOTE 3 On sites where the CBR varies from place to place, the lowest recorded values should be used or appropriate designs should be provided for different parts of the site using the lowest CBR recorded in each part. It may be possible to remove soft spots and therefore ignore those low CBR values which relate to the removed material.

NOTE 4 Soft spots should be removed and replaced with suitable material.

NOTE 5 Care should be exercised in the interpretation of site investigation data. In the case of soils whose strength is a function of their moisture content the in-service strength may be much lower than the recorded values. Care should also be exercised in using CBR values measured in summer as artificially high figures may be obtained due to dryness of the soil.

NOTE 6 Particular care should be exercised with subgrades having measured CBRs of 3 % or less.

[a] The bracketed figures should be considered if these materials are likely to become saturated in service.

Table 2 — Typical application

Category	Maximum trafficking (msa)	cv/d	Typical applications
I	>0.5	—	Use BS 7533-1
II	0.5	≥ 5	Adopted highways and other roads less than 0.5 msa, e.g. culs-de-sac, petrol station forecourts, pedestrianized areas subject to regular heavy trafficking
		<5	Car parks receiving occasional heavy traffic Footways regularly overridden by vehicular traffic
IIIa	—	<1	Pedestrianized areas receiving only occasional heavy traffic Footways overridden by occasional vehicular traffic
IIIb	—	Nil	Car parks receiving no heavy traffic Footways likely to be overridden by no more than occasional vehicular traffic
IV	—	—	Private drives, paths, patio, hard landscaping Areas receiving pedestrian traffic only, e.g. school playgrounds

NOTE 1 Access ways to commercial and business premises and public buildings should be placed either in category II or IIIa depending upon the estimate of the total commercial vehicle traffic likely to use the pavement.

NOTE 2 In determining the site category, the use of the surface of the pavement by any construction traffic should be assessed and used in traffic calculations.

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Table 3 — Standard axles per commercial vehicle

Vehicle type	Conversion factor
Buses and coaches	1.3
2 axle rigid	0.34
3 axle rigid	1.7
3 axle articulated	0.65
4 axle rigid	3.0
4 axle articulated	2.6
5 axles or more	3.5

4.3 Additional design factors

The design method can be applied directly to the majority of applications. However, in some cases, such as those outlined in a) to b), unusual or particularly onerous loading effects or other conditions should be taken into account.

a) Where relatively few standard axles are to be accommodated (less than 100 000) but where the loading is commonly applied by axle loads in excess of 7 000 kg, the pavement should be designed to withstand either 100 000 standard axles or three times the actual number of standard axles, whichever is the greater.

b) Where channelized traffic on pavements in categories II and III (see Table 2) is expected, the traffic figures should be multiplied by three before carrying out the design, to allow for the increase in the concentrated application of loads at a particular point on the pavement. Normal lane widths in a highway do not generally constitute channelized traffic but channelized traffic can develop on any road, e.g. on steep hills or approaches to traffic signals, or entrances to parking areas, and can be induced by some traffic calming measures.

If the application of this factor leads to traffic exceeding 0.5 msa, the design should be carried out in accordance with BS 7533-1.

4.4 Materials

Materials whose successful performance is dependent upon compaction being undertaken at critical moisture contents should only be used when engineering supervision can ensure that a stable construction can be achieved.

Pavements in categories II and III (see Table 2) constructed over frost-susceptible soils should have an overall thickness of non frost-susceptible material of at least 450 mm.

5 Determination of construction thickness

Having assessed the category of application (see Table 2) and the design CBR (see Table 1), the thickness of each pavement layer should be determined in accordance with Table 4 or Table 5.

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Table 4 — Construction thickness

Category	Minimum compacted sub-base thickness mm					Nominal compacted thickness mm		Minimum paver thickness mm
	Design CBR							
	≤2 %	3 %	4 %	5 %	≥6%	Roadbase	Laying course	
Category II	400	350	250	150	150	125	30	60
Category IIIa	350	300	225	150	150	Nil	50	50
Category IIIb	300	250	175	100	100	Nil	50	50
Category IV	200	150	125	100	Nil	Nil	50	50
Other roads up to 100,000 sa	200	150	125	100	100	100	30	60

NOTE 1 For category I designs refer to BS 7533-1.

NOTE 2 Under adverse weather conditions, or for CBRs of 2 % or less, the use of a suitable geotextile separating membrane is recommended.

NOTE 3 The thickness of the sub-base makes no allowance for it to be used as a site access way during construction.

NOTE 4 Where a category IIIa pavement may be used as an access road during construction or where the heavy vehicles using the pavement consist of heavy trucks or large buses with axle loads of 8 t, the use of a bound roadbase is recommended as shown in Table 5.

NOTE 5 For guidance on suitable materials see BS 7533-3.

Table 5 — Alternative construction thickness (in millimetres) for category IIIa sites only

Category	Minimum compacted sub-base thickness mm					Nominal compacted thickness mm		Minimum paver thickness mm
	Design CBR							
	≤2 %	3 %	4 %	5 %	≥6%	Roadbase	Laying course	
Category IIIa	250	150	100	100	0	70	30	50

NOTE 1 Under adverse weather conditions, or for CBRs of 2 % or less, the use of a suitable geotextile separating membrane is recommended.

NOTE 2 For guidance on suitable materials see BS 7533-3.

NOTE 3 The thickness of the sub-base makes no allowance for it to be used as a site access way during construction.

6 Preparation and construction

Detailed preparation of the subgrade should be in accordance with the recommendations in BS 7533-3.

Where bituminous roadbase is used, it should be 20 mm nominal size dense bitumen macadam (DBM) conforming to BS 4987-1 with 100 pen binder, laid in two layers. Where cement bound material (CBM) is used it should be either CBM 1A or CBM 2 with minimum individual 7 day compressive strength of 4.5 N/mm^2.

7 Overlay design

When an existing part of a worn pavement is to be overlain, the design should be undertaken using a component overlay design method in accordance with the recommendations in BS 7533-1.

When existing flexible roads are to be overlain, the design should be undertaken using a deflection-based method in accordance with the recommendations in BS 7533-1. When other types of roads or industrial areas are to be overlain, the component overlay method should be used.

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Annex A (informative)
Identification of materials and CBR values using a simple field test

Table A.1 provides a method of identification for materials and CBR values using a simple field test.

Table A.1 — Identification of materials and CBR values using a simple field test

Rock or soil		Simple field test	CBR	Comments
Type	Condition			
Rock	Hard	Requires mechanical pick for excavation	Above 5 %	
Sand Gravel	Compact	50 mm square peg hard to drive in 150 mm	>5 %	
Clay Sandy clay	Stiff	Cannot be moulded by fingers Need pick for excavation	5 %–2 %	
Clay Sandy clay	Firm	Can be moulded by fingers Need spade for excavation	5 %–2 %	
Sand Silty clay Clayey sand	Loose	Dry lumps easily broken down 50 mm square peg driven in easily	2 %	
Silt Sandy clay Silty clay Clay	Soft	Can easily be moulded by fingers	<2 %	
Silt Sandy clay Silty clay Clay	Very soft	Exudes between fingers when squeezed	Seek specialist advice	
NOTE 1 This table is based on the principles in BS 8103-1. NOTE 2 The CBR of the rock or soil is significantly affected by moisture content.				

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BS 8103-1:1995, *Structural design of low-rise buildings — Part 1: Code of practice for stability, site investigations, foundations and ground floor slabs for housing.*

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